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FLOOD INSURANCE STUDY

CITY OF FREDERICK, MARYLAND
FREDERICK COUNTY

COMPLETED

JUNE 15, 1988

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Federal Emergency Management Agency

COMMUNITY NUMBER - 240030

ORIGINAL

NOTICE TO
FLOOD INSURANCE STUDY USERS

This Flood Insurance Study was revised on June 15, 1988. Users should refer to the Revision Description section (Section 9.0) of this text for further information.

Part or all of this Flood Insurance Study may be revised at any time. The user is therefore cautioned that a published map revision (i.e., a revised Flood Insurance Rate Map) may not include a reprinting of the text, tables, and/or profiles, resulting in a discrepancy between the revised map and the original study components. It is the responsibility of the user to consult with community officials to obtain the most current Flood Insurance Study components.

Initial Flood Insurance Study Effective Date: August 8, 1980

Flood Insurance Study Revised: June 15, 1988

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance study purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
	1.1 Purpose of Study	1
	1.2 Coordination	1
	1.3 Authority and Acknowledgements	1
2.0	AREA STUDIED	2
	2.1 Scope of Study	2
	2.2 Community Description	2
	2.3 Principal Flood Problems	5
	2.4 Flood Protection Measures	9
3.0	ENGINEERING METHODS	10
	3.1 Hydrologic Analyses	10
	3.2 Hydraulic Analyses	12
4.0	FLOOD PLAIN MANAGEMENT APPLICATIONS	15
	4.1 Flood Boundaries	15
	4.2 Floodways	16
5.0	INSURANCE APPLICATION	25
	5.1 Reach Determinations	26
	5.2 Flood Hazard Factors	27
	5.3 Flood Insurance Zones	27
	5.4 Flood Insurance Rate Map Description	28

TABLE OF CONTENTS - continued

	Page
6.0 OTHER STUDIES	28
7.0 LOCATION OF DATA	31
8.0 BIBLIOGRAPHY AND REFERENCES	31
9.0 REVISION DESCRIPTION	35
9.1 Purpose	35
9.2 Acknowledgments	35
9.3 Scope	35
9.4 Hydrologic and Hydraulic Analyses	35
9.5 Revisions Bibliography	36
9.6 Location of Data	36

FIGURES

Figure 1 - Vicinity Map	3
Figure 2 - Looking East on E. Patrick Street, June 1972	6
Figure 3 - Aerial View of Flooding in Baker Park, June 1972	6
Figure 4 - Flooding Along Carroll Creek, September 1975	7
Figure 5 - Floodway Schematic	26

TABLES

Table 1 - Summary of Discharges	13
Table 2 - Floodway Data	17 - 24
Table 3 - Flood Insurance Zone Data	29 - 30
Table A - Summary of Discharges Addendum	36

TABLE OF CONTENTS - continued

EXHIBITS

Exhibit 1 - Flood Profiles		
Carroll Creek	Panels 01P-04P	37-40
Rock Creek	Panels 05P-09P	41-45
Tributary No. 5	Panel 10P	46
Tributary No. 6	Panels 11P-15P	47-51
Tributary No. 8	Panels 16P-17P	52-53
Tributary No. 9	Panels 18P-19P	54-55
Tributary No. 10	Panel 20P	56
Tributary No. 11	Panel 21P	57

Exhibit 2 - Flood Boundary and Floodway Map Index

Exhibit 3 - Flood Boundary and Floodway Map

PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index

Flood Insurance Rate Map

FLOOD INSURANCE STUDY
CITY OF FREDERICK, MARYLAND

1.0 INTRODUCTION

1.1 Purpose of Study

The purpose of this Flood Insurance Study is to investigate the existence and severity of flood hazards in the City of Frederick, Frederick County, Maryland, and to aid in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Initial use of this information will be to convert Frederick to the regular program of flood insurance by the Federal Insurance Administration (FIA). Further use of the information will be made by local and regional planners in their efforts to promote sound land use and flood plain development.

1.2 Coordination

The identification of streams requiring detailed study was made at a meeting attended by personnel from Dalton•Dalton•Littlee•Newport, the FIA, and officials of the City of Frederick in February 1975. A coordination meeting was held in Frederick on September 30, 1975, with community officials, concerning the nature and purpose of the study, the general principles to be applied, the methods to be used, and the use to be made of the data.

During the course of the work by Dalton•Dalton•Littlee•Newport, periodic contacts were made with the City Engineer of Frederick to obtain necessary data required for the completion of the study.

The results of the work by Dalton•Dalton•Littlee•Newport were reviewed at a final Coordination Meeting held August 10, 1976. The final Coordination Meeting was attended by the study contractor, the FIA, and the city engineer. The study was acceptable to the officials of the community.

1.3 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968, as amended.

The hydrologic and hydraulic analyses for this study were performed by Dalton•Dalton•Littlee•Newport for the FIA, under Contract No.

H-3810. This work, which was completed in October, 1976, covered all flooding sources in the City of Frederick.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Frederick. The area of study is shown on the Vicinity Map (Figure 1).

The limits of the detailed and approximate studies in the City of Frederick, Maryland, were determined by the FIA after consultation with the community and the study contractor. Areas studied in detail were Carrol Creek and one tributary (Tributary No. 6), Rock Creek and one tributary (Tributary No. 5), and four tributaries of the Monocacy River (Tributaries No. 8, 9, 10, and 11). An approximate analysis was performed on a portion of Rock Creek between Willowdale Drive and Elmwood Drive. The Monocacy River was not scheduled to be studied in detail in this report but a detailed analysis was required, and performed, on the Monocacy River to determine backwater effects of the river on its tributaries.

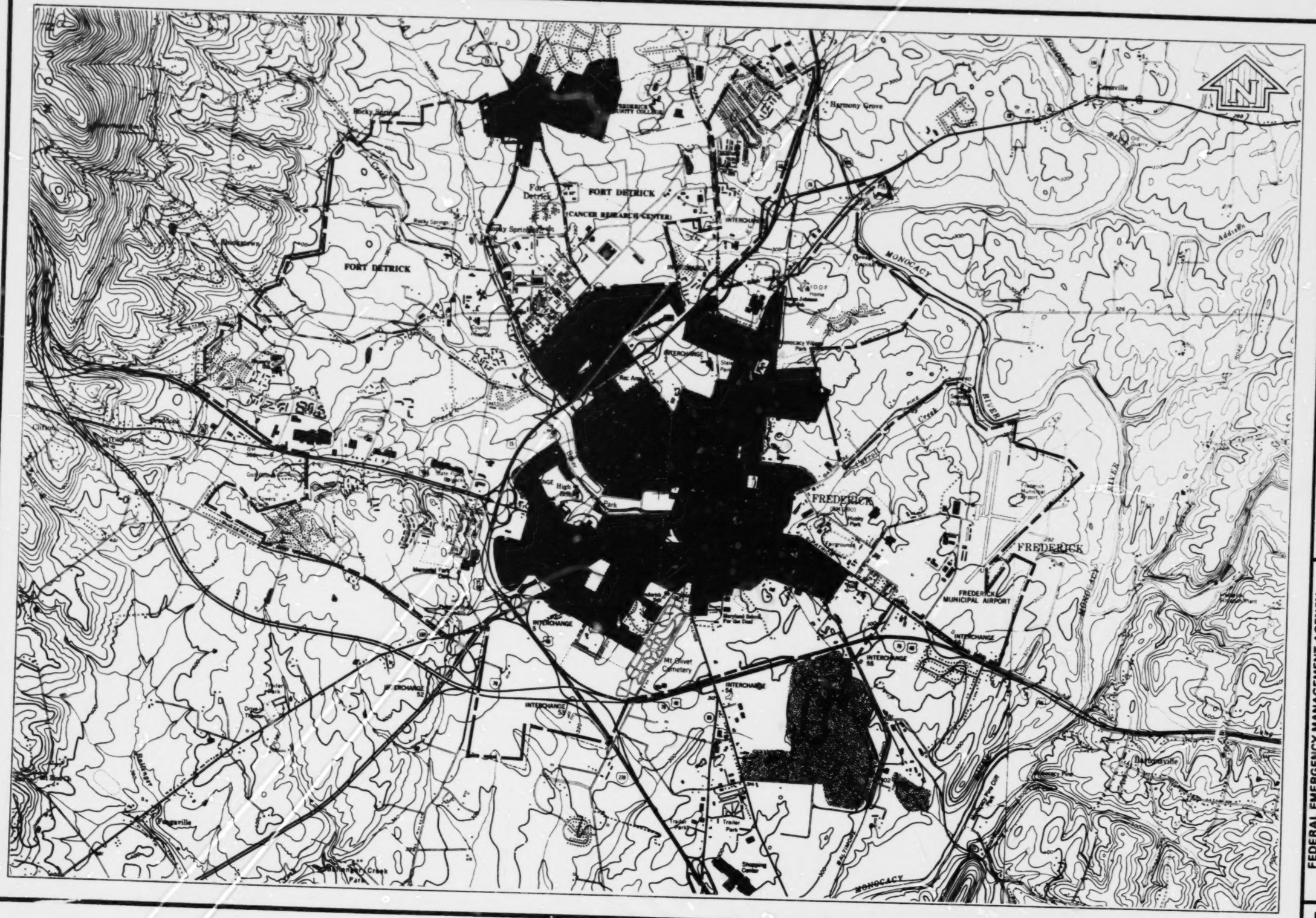
The areas studied in detail were chosen with consideration given to forecasted development for the next five years (through July, 1980).

2.2 Community Description

The City of Frederick is located along and nearby the west bank of the Monocacy River in the center of Frederick County, Maryland. The city is approximately 45 miles northwest of Washington, D. C., on the western edge of the Piedmont Province.

Topography in the area is generally rolling although within the city the terrain is considered gently rolling. The western city limits extend to the foot of Catoctin Mountain. Slopes within the city rarely exceed five percent and elevations range from a minimum of about 260 feet above sea level along the eastern boundary at the Monocacy River to a maximum of 480 feet above sea level at the western boundary. The urbanized center-city area ranges in elevation from 300 to 340 feet above sea level.

The area surrounding the city is predominantly agricultural. Within the city boundaries, most of the area beyond the central core area


N
FORT DETRICK
(CANCER RESEARCH CENTER)
FREDERICK
FREDERICK MUNICIPAL AIRPORT
MONOCACY
RIVER
Harmony Grove
Mt. Olivet Cemetery
INTERCHANGE 52
INTERCHANGE 53
INTERCHANGE 54
INTERCHANGE 55
INTERCHANGE 56
Fort Detrick
Rocky Springs
Creek
Fairview
Braddock
Clifton
Jefferson
Gas
Water Tower
Trailer Park
Park
Old Quarry
Addiso Rd
Baltimore
Pike
Creek
Fairfield
Fingerville
Baughman's Creek Park
Stevens Center
Monocacy Park
Dist. Park
Municipal Airport
Maryland School for the Deaf
Frederick Municipal Airport
Frederick County College
100F Home
Rec. Area
Interchange
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Interchange 54
Interchange 53
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is likewise heavy in agricultural uses, with the exception of the Fort Detrick reservation.

Although Frederick has been increasing in population over the years the rate of growth has generally been decreasing. From 1940 to 1960 the population increased an average of nearly two percent per year, from 15,802 persons to 21,744 persons. Since 1950, however, the growth rate has been about 0.75 percent per year. The 1970 census population for Frederick was 23,641 persons. Current population is estimated at 27,500 persons which represents an increase in population of over 16 percent in five years. Much of this increase is the result of the annexation of a considerable area surrounding the city since 1970.

Much of the land area of Frederick is undeveloped. The most intensively developed area is confined to the central area of the city, between U. S. Route 15 and to within 3,000 feet of the Monocacy River. West of U. S. Route 15, in the area of recent annexation, since 1968, development is restricted to corridors along existing roads.

Fredericktown was originally laid out in 1745, three years before the creation of Frederick County (Reference 1). In 1750 the town became the county seat (Reference 2). Originally called Fredericktown, the community was incorporated in 1817 and "town" was dropped from the name. The area of the city has increased substantially since 1968 through annexation to a size now of approximately 12.25 square miles, and is the eighth largest city in the State of Maryland.

The city lies at the junction of Interstate Routes I-70 from Baltimore and I-270 from Washington, providing excellent highway access to the major metropolitan areas of Maryland. While these major highway routes skirt the southern city boundary, another major freeway, U. S. Route 15, provides direct access to the freeway system as it traverses the city on its route north toward Harrisburg, Pennsylvania. Frederick is also served by the B&O Railroad and CONRAIL.

Climatic conditions in Frederick are moderate with warm summers and moderately cold winters. The normal growing season averages 160 days from mid April to mid September. The average annual temperature is 54°F and ranges from an average minimum of 32°F in January to an average maximum of about 76°F in July. The mountains to the west have a moderating effect on the climate of Frederick, especially in reducing the effects of cold outbursts of arctic air. Average annual precipitation is 39 inches and is rather evenly distributed

through the year with August the wettest month and February the driest. Heavy precipitation during the colder half of the year is mostly the result of low pressure systems moving along the Atlantic Coast while in the summer it occurs mostly during thunderstorms of high intensity but short duration.

Vegetation within the community is typically urban in nature in the center core area consisting of lawn grasses and ornamental trees and shrubs. Elsewhere within the city boundaries the land is nearly completely in agricultural uses.

2.3 Principal Flood Problems

Flooding in Frederick has historically been from the backwaters of the Monocacy River, which flows along the eastern boundary of the city, and from Carroll Creek, which flows in a westerly direction through the center of the city.

While the flooding due to the Monocacy River is deeper, over a larger area, and of longer duration, the flood prone areas are not intensively developed and advance warning of pending flood conditions is provided to flood prone area residents.

Flooding along Carroll Creek is not very deep and not much area is affected, however, between Highland Street and N. Bentz Street the overbank areas are intensively developed with commercial and industrial uses. In addition, flooding from Carroll Creek can result from short duration, intensive storms which create flash flood situations and little warning is available to protect against high water damage.

Flooding in Frederick during the 1972 flood, Agnes, actually came in two phases. First, the flash flood conditions along Carroll Creek inundated many businesses along the banks with water at the E. Patrick Street crossing of Carroll Creek as deep as three feet. As the flooding from Carroll Creek receded, the waters of the Monocacy River began to rise until about two days later, the backwater from the river had flooded the E. Patrick Street area to a depth of nearly seven feet (Reference 3). The recurrence frequency for the floods on the Monocacy River was approximately once in 250 years for the 1972 flood and once in 75 years for the 1975 flood. The recurrence frequency for the 1972 flood on Carroll Creek cannot be reliably assessed due to the lack of discharge data but it is estimated to be once in less than five to 10 years. Photographs of flooding in Frederick during the 1972 and 1975 floods are shown in Figures 2, 3, and 4.

Figure 2. Looking east on E. Patrick St. from near Wisner St. toward the Carroll Creek crossing during flood of June 1972, Agnes (Reference 3).

Figure 3. Aerial view of flooding in Baker Park west of Bentz St. during flood of June 1972, Agnes (Frederick News Post).

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Figure 4. Aerial view of flooding along Carroll Creek between E. Patrick St. and the Monocacy River during flood of September 1975, Eloise.

Many of the businesses located along Carroll Creek in the center city area experience flooding from relatively minor storms just as other locations within the urbanized area of the city also experience occasional flooding when the capacity of the storm drainage system is exceeded.

The flooding source in Frederick that has historically caused property damage is Carroll Creek, which runs almost due west from the Monocacy River and nearly divides the city in half. From N. Bentz Street easterly to Highland Street, overbank areas have been developed up to the banks of the stream, confining the flow to a narrow channel with numerous road crossings. This area is heavily developed in industrial and commercial uses and the damage potential from the 100-year flood is high. West of Bentz Street the flood plain has been reserved as a park area and damage from flooding has been negligible by comparison.

Of the water courses identified by the community officials as sources of potential flood hazard, only the Monocacy River and Carroll Creek can be considered major hazards to current development adjacent to these waterways. Flooding of other streams in Frederick may occur but the damage potential is light, primarily because in general the flood plain has not yet been encroached upon by building. There are two exceptions to this; one, on Rock Creek west of Willowdale Drive, where a recently constructed shopping center parking lot is subject to flooding from severe storms; and two, a small tributary to the Monocacy River, Tributary No. 8, just north of Carroll Creek, where between East Avenue and Motter Avenue the stream is enclosed and severe storms may cause flooding of streets and low lying areas.

The sewage treatment plant for Frederick is located on the banks of the Monocacy River at the confluence of Carroll Creek. It is not uncommon for flood waters from the river to reach this facility causing temporary shut down and raw sewage discharge into the river. The 1972 flood caused considerable damage to the treatment plant and interrupted operation of the plant for one week. The 1975 flood likewise damaged the plant but to a lesser degree and operation was resumed several days after the flood waters receded.

The water treatment facilities for the city are also located on the Monocacy River but farther upstream at the mouth of Tributary No. 11. During the 1972 flood the pumps were pulled as a precaution but the flood did no significant damage to the plant.

2.4 Flood Protection Measures

Although severe flooding problems in Frederick are due to the back-water effects of the Monocacy River, there is nothing that the city can do to protect existing structures except provide warnings of anticipated flood conditions.

Carroll Creek, however, is a source of flooding problems in the city that is within the province of the city to provide some protection. Much of the economy of the city is affected by flooding from Carroll Creek. A study prepared for the city (Reference 4) recommends the construction of storm water detention facilities upstream of the city and channel improvements between Bentz Street and Highland Street. The study was completed in April 1975 and the city has selected a number of the report recommendations for implementation. The city has initiated the process by which the Soil Conservation Service (SCS) will consider constructing storm water detention facilities upstream of Frederick on Carroll and Rock Creeks. These facilities are not expected to be actually constructed, if determined feasible by the SCS, for at least eight to 10 years.

The city has initiated the design process to increase the channel of Carroll Creek to equal the capacity of the bridges, which will reduce the flood elevations. The design is in the conceptual stage; no funds have been allocated for construction and the city engineer estimates that the earliest probable date for construction is 1978. Based upon the status of the proposed improvements to Carroll and Rock Creeks, all the flood determinations in this report are based on existing conditions.

The sewage treatment plant on the banks of the Monocacy River is actively under consideration for expansion to meet the city's need for increased capacity. As part of the planning for expansion of the sewage treatment capacity for the city, one alternative under consideration is the construction of flood protection measures to reduce the flood hazard to the plant. Another alternative, suggested by the Environmental Protection Agency to reduce the probability of raw sewage spills into the river during flood stages, is to relocate the plant out of the flood prone area. No decision has been made by the city although the cost of abandoning the present treatment plant for a new plant at a new location seems prohibitive. The form, extent and effect of flood protection measures for the existing plant have not been established. Therefore, the flood elevations determined in this study for the Monocacy River and Carroll Creek are based on existing conditions.

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3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Floods having recurrence intervals of 10, 50, 100, and 500 years have been selected as having special significance for flood plain management and for flood insurance premium rates. The analyses reported here reflect current conditions in the watersheds of the flooding sources.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each stream studied in detail in the community.

The peak discharge-frequency relationships at different locations were determined using Synder's synthetic flood frequency method (Reference 5). The major portions of the watershed areas for the streams in the community are predominantly urban in character. Although there are two USGS gages in the vicinity, the discharge records of both these gages do not particularly reflect runoff characteristics of predominantly urban watersheds. The gage on the Monocacy River near Jug Bridge is located downstream of the community and receives the entire runoff discharge of the Carroll Creek system, which passes through the community. The watershed area at the gage, however, is very large (817 sq. miles) compared to the urban watershed area of the community and, therefore, does not accurately reflect the runoff characteristic of an urban area. It was, therefore, considered inappropriate to use the recorded discharges at either of the USGS gages in the vicinity to develop the peak discharge-frequency relationships at locations within the City of Frederick. Synthetic flood frequency relationships were developed using Snyder's method with the aid of the storm drainage maps of the City of Frederick and the Rainfall Frequency Atlas of the United States (Reference 6).

Discharges for the various frequency floods obtained using Snyder's method under the existing condition of the watershed were compared with the discharges for similar frequency floods developed in the study prepared for the City of Frederick by Dewberry, Nealon and Davis (Reference 4). The flood discharges determined for that study were based upon ultimate development of the watershed. Comparison of the discharges, considering the basis of calculation, indicated good agreement; therefore, the discharges computed in the report for the city were accepted and were the basis of the hydraulic determinations.

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Although the Monocacy River near Frederick was designated by the community officials for approximate study, a detailed study was made both upstream and downstream to determine the 10-, 50-, 100-, and 500-year profiles; these profiles were then used to establish the starting water-surface elevations for Carroll Creek and the other tributaries marked for detailed study. It was, therefore, necessary to make frequency analysis of the recorded peak annual discharges of the USGS gage on the Monocacy River near Jug Bridge.

For purposes of predicting 10-, 50-, 100-, and 500-year flood magnitudes, using statistical analysis of recorded peak discharges, stream gaging stations were classified into three main groups as follows:

Class I gages - Stations having 40 or more years of continuous records.

Class II gages - Stations having between 25 and 40 years of records.

Class III gages - Stations having less than 25 years of records.

Continuous peak discharge records of the gage at Jug Bridge (#016430000) were obtained from the USGS. Computer printouts of frequency analyses of the gage using the log-Pearson Type III distribution (References 7 and 8) were also obtained from the USGS. This gage has 47 years of continuous records and is, therefore, designated as Class I. Based on the lengths of records, floods with the following frequencies can be reliably predicted from a standard frequency analysis:

Class I gage - 100-year frequency
Class II gage - 50-year frequency
Class III gage - 25-year frequency

A frequency analysis of recorded peak discharges at the Jug Bridge gage was made using the log-Pearson Type III distribution technique (recommended by Water Resources Council References 7 and 8). Similar analyses made by the USGS used a computed skew coefficient which was found to be erratic due to the short period of record, and therefore, not considered sufficiently reliable. A new analysis was made using the map showing the isopleths of generalized skew coefficients of annual peak discharges prepared by the USGS (References 8 and 9). In this frequency analysis the plotted positions of existing data were based on the Gringorten formula (References 10 and 11), since this method produced a better fit when used in the log-Pearson Type III distribution analyses. In accordance with the directive issued by the FIA no expected probability adjustment was made in the frequency analysis.

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In order that the results of frequency analyses at the Jug Bridge gage could be projected to different locations on the Monocacy River, both upstream and downstream of the City of Frederick, curves of the drainage area-peak discharge relationship were prepared using records of the gages in Frederick and Carroll Counties which were judged to have sufficiently similar drainage basin characteristics. Mean values of peak discharges were calculated and plotted against drainage areas on log-log graph paper from which the equations of the best-fit curves were derived. Relationships were then developed between drainage area and discharge to allow projection of discharges for selected frequency floods to different locations of the gaged watersheds and also to ungaged watersheds having similar basin characteristics. These projection equations took the following general form:

$$\frac{Qs}{Qg} = \left(\frac{As}{Ag}\right)^{n_1} \frac{As\,(p \log As)}{Ag\,(p \log Ag)} \quad \text{for parabolic relationships}$$

$$\frac{Qs}{Qg} = \left(\frac{As}{Ag}\right)^{n_2} \quad \text{for straight line relationships}$$

where Qg and Ag are the discharge and drainage area at the gage, Qs and As the discharge and drainage area at the site in question, "p" is a coefficient, and "n_1" and "n_2" are exponents.

Based upon this relationship the various peak discharges on different locations of the Monocacy River were projected from the corresponding results of frequency analysis of the Jug Bridge gage.

The 500-year peak flood discharges for all the creeks marked for detailed study in the community were obtained by plotting the 10-, 25-, 50-, and 100-year peak flows on log-probability paper and extrapolating to the 500-year frequency.

Drainage area-peak discharge relationships for the flooding sources studied in detail are shown in Table 1.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the streams studied in detail in the community were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of these streams.

For streams studied in detail, water-surface elevations of floods of the selected recurrence intervals were computed through use of the

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TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
CARROLL CREEK					
Upstream of Confluence with Monocacy River	17.40	5,090	6,750	7,600	10,000
Patrick Street	15.81	4,680	6,100	7,010	9,400
Bentz Street	13.56	4,300	5,830	6,800	9,100
Downstream of Confluence with Tributary No. 6	13.22	3,966	5,671	6,555	8,800
Downstream of Confluence With Rock Creek	11.67	3,960	5,400	6,237	8,600
Upstream of Confluence with Rock Creek	7.07	2,542	3,507	4,055	5,500
ROCK CREEK					
Upstream of Confluence with Carroll Creek	4.60	1,621	2,229	2,522	3,500
Downstream of Confluence with Tributary No. 5	3.85	1,405	1,910	2,248	3,050
Upstream of Confluence with Tributary No. 3	2.18	808	1,186	1,306	1,800
TRIBUTARY NO. 5					
Upstream of Confluence with Rock Creek	0.36	412	522	584	750
Cross Section C	0.10	143	184	202	250
TRIBUTARY NO. 6					
Upstream of Confluence with Carroll Creek	0.82	344	474	540	720
Route 15	0.34	136	218	258	430
TRIBUTARY NO. 8					
Beginning of Detailed Study	0.94	789	1,049	1,187	1,630
Cross Section B	0.84	681	920	1,023	1,400
North Market Street	0.31	265	360	410	540
TRIBUTARY NO. 9					
Confluence with Monocacy River	0.97	316	490	590	980
TRIBUTARY NO. 10					
Upstream of Confluence with Monocacy River	0.81	245	371	441	720
TRIBUTARY NO. 11					
Upstream of Confluence with Monocacy River	0.35	137	214	252	420

COE HEC-2 standard step backwater computer program (References 12, 13, 14, and 15).

An important element of the backwater profile computation is the determination of a water-surface elevation at the beginning cross section. To establish a beginning point water-surface elevation a methodology developed by Dalton•Dalton•Little•Newport (Reference 16) was used to overcome the lack of data necessary to utilize the options provided by the HEC-2 program and to obtain an accurate elevation without beginning the calculations at an excessive length downstream of the community boundary. Using this computer program the computation of water-surface profiles for the Monocacy River was commenced at a section downstream of Frederick and progressed upstream since the flow is subcritical. The water-surface profiles of the Monocacy River provided the starting water-surface elevations for all tributaries of the Monocacy studied in detail in the community. Similarly, the computed water-surface profiles for Carroll Creek and Rock Creek provided the starting water-surface elevations for tributaries, studied in detail, to these flooding sources.

Cross sectional information including the overbank portions, details of structures such as bridges and culverts, and the profiles of the top of the roadway were obtained through field surveying and field reconnaissance. Cross section data from a previous study on Carroll Creek, Rock Creek, and Tributaries 5, 6, and 8, made by Dewberry, Nealon and Davis for the City of Frederick (Reference 4), were utilized for the present study, after making spot verifications in the field to assess accuracy. Supplemental cross sections as well as additional sections and details of bridges and culverts were obtained through field surveying.

Locations of selected cross sections, used in the hydraulic analyses, are shown on the Flood Boundary and Floodway Map (Exhibit 3).

Estimates of Manning's roughness values for the channel and the overbanks at each cross section were assigned from information collected in the field regarding vegetation and surface soils and irregularities. The initial estimates of roughness coefficients as well as other parameters, such as bridge loss coefficients, weir coefficients, etc. were slightly modified on the Monocacy River to make the computed water-surface profile pass through the stage-discharge relationships at the gage downstream of Frederick. Roughness values for the stream channel of the Monocacy River varied from 0.015 to 0.04 and for overbank areas from 0.03 to 0.08. For all streams studied in detail, roughness values varied from 0.016 to 0.040 in the channels and from 0.030 to 0.10 in the overbank areas.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1). Where the elevation difference between profiles was too small to plot the various floods only the 100-year profile is shown. All elevations were referenced from the City of Frederick datum using elevations provided by the city engineer. To convert the city elevations to the National Geodetic Vertical Datum of 1929 (NGVD 1929) formerly referred to as Mean Sea Level with 1929 general adjustment, a correction factor of 0.61 feet must be subtracted from the city elevation.

The hydraulic analyses for this study are based only on the effects of unobstructed flow. The flood elevations, as shown on the profiles, are thus considered valid only if hydraulic structures in general remain unobstructed.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

A prime purpose of the National Flood Insurance Program is to encourage state and local governments to adopt sound flood plain management programs. Each Flood Insurance Study, therefore, includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FIA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100- and 500-year flood have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at a scale of 1"=2,000' with a contour interval of 20 feet (Reference 19) enlarged to a scale of 1"=500'. Photogrammetric mapping at a scale of 1"=200' dated 1974, provided by the City Engineer of Frederick (Reference 20), was used on Carroll Creek and Rock Creek to aid in defining the shape of flood boundaries. In cases where the 100-year and the 500-year flood boundaries are close together, only the 100-year boundary has been shown.

The 100-year boundary determined by approximate methods, for the portion of Rock Creek between Willowdale Drive and Elmwood Drive, was

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delineated using field inspection, knowledge of past flooding, and engineering judgement.

Although the Monocacy River was studied in detail to determine backwater effects on its tributaries. a detailed analysis of overbank flooding in the city from the Monocacy River was not required by DaltonDaltonLittleNewport under terms of their contract. Therefore, the overbank flooding from the Monocacy River, has been shown as an area studied by approximate methods. The boundary of the 100-year flood was developed from step-backwater computations and the topographic maps referenced above.

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 3). Small areas within the flood boundaries may lie above the flood elevations, and therefore, not be subject to flooding; owing to limitations of the map scale, such areas are not shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood be carried without substantial increase in flood heights. Minimum standards of FIA limit such increases in flood heights to one floot, provided that hazardous velocities are not produced. The floodways in this report are presented to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

The floodway presented in this study was computed on the basis of equal conveyance reduction from each side of the flood plain. The results of these computations are tabulated at selected cross sections for each stream studied in detail (Table 2).

Floodway encroachment stations were determined on the basis that the rise of the 100-year flood elevation would be limited to one foot.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	WITH FLOODWAY (F.C.D.)	WITHOUT FLOODWAY (F.C.D.)	DIFFERENCE (FT.)
Carroll Creek							
A	660	130[2]	1,162	6.54	256.2	255.2[3]	1.0
B	805	173[2]	1,271	5.98	256.5	255.5[3]	1.0
C	2,815	234	1,444	5.26	258.6	258.0[3]	0.6
D	3,110	221	1,159	6.56	259.1	258.4[3]	0.7
E	3,665	349	2,049	3.71	261.8	261.3[3]	0.5
F	4,420	180	1,281	5.93	263.0	262.5[3]	0.5
G	5,325	178	1,130	6.73	265.4	264.7[3]	0.7
H	6,160	403	2,327	3.18	267.5	266.8[3]	0.7
I	7,265	230	853	8.68	268.0	267.7[3]	0.3
J	7,425	288	1,231	6.02	272.0	271.0	1.0
K	7,900	421	1,927	3.84	272.5	271.5	1.0
L	8,450	160	690	10.16	272.9	272.9	0.0
M	8,535	259	1,347	5.21	274.6	273.6	1.0
N	8,730	273	1,652	4.24	275.0	274.0	1.0
O	9,335	343	1,532	4.58	275.5	274.5	1.0
P	9,520	669	2,540	2.76	276.0	275.2	0.8
Q	9,625	468	1,663	4.22	276.1	275.3	0.8

[1]FEET ABOVE MOUTH [2]PORTION OF FLOODWAY LOCATED OUTSIDE CORPORATE LIMITS
[3]THE 100-YEAR FLOOD ELEVATION ON THE PROFILE IS DUE TO MONOCACY RIVER BACKWATER

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF FREDERICK, MD
(FREDERICK CO.)

FLOODWAY DATA

CARROLL CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	WITH FLOODWAY (F.C.D.)	WITHOUT FLOODWAY (F.C.D.)	DIFFERENCE (FT.)
Carroll Creek Continued							
R	9,725	454	1,164	6.02	276.1	275.7	0.4
S	9,860	348	1,971	3.56	279.7	278.9	0.8
T	10,000	369	1,843	3.80	279.7	278.9	0.8
U	10,075	314	2,550	2.75	279.9	279.0	0.9
V	10,570	179	1,299	5.40	279.9	279.1	0.8
W	10,800	164	1,185	5.92	283.2	283.2	0.0
X	11,150	164	1,746	4.01	285.3	285.3	0.0
Y	11,600	213	1,175	5.97	285.4	285.4	0.0
Z	11,750	195	1,536	4.56	285.6	285.6	0.0
AA	12,150	275	2,034	3.45	286.2	286.2	0.0
AB	12,500	202	1,520	4.61	286.3	286.3	0.0
AC	12,985	174	1,106	6.34	286.4	286.4	0.0
AD	13,405	349	2,074	3.38	287.6	287.0	0.6
AE	13,485	364	1,953	3.48	287.8	287.2	0.6
AF	14,315	158	992	6.85	288.0	287.5	0.5
AG	14,565	166	1,258	5.40	291.7	291.7	0.0

[1]FEET ABOVE MOUTH

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF FREDERICK, MD
(FREDERICK CO.)

FLOODWAY DATA

CARROLL CREEK

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	WITH FLOODWAY (F.C.D.)	WITHOUT FLOODWAY (F.C.D.)	DIFFERENCE (FT.)
Carroll Creek Continued							
AH	15,870	240	1,898	3.45	292.8	292.6	0.2
AI	16,085	622	1,838	3.57	294.3	294.2	0.1
AJ	16,985	232	1,449	4.52	295.4	295.3	0.1
AK	17,585	267	1,221	5.11	296.3	295.9	0.4
AL	17,685	284	1,064	5.86	296.5	296.1	0.4
AM	17,865	175	1,212	5.15	297.2	297.2	0.0
AN	18,225	179	1,215	5.13	298.1	297.7	0.4
AO	18,385	222	1,456	4.28	299.9	299.8	0.1
AP	19,215	140	687	9.08	300.9	300.7	0.2
AQ	19,550	724	5,921	1.05	308.1	307.7	0.4
AR	20,700	301	2,115	1.92	308.2	307.7	0.5
AS	20,815	205	1,195	3.39	308.3	307.9	0.4
AT	21,565	194	955	4.25	308.6	308.3	0.3
AU	21,735	368	3,108	1.30	313.7	312.7	1.0
AV	22,875	413	2,960	1.37	313.9	313.0	0.9

[1]FEET ABOVE MOUTH

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF FREDERICK, MD
(FREDERICK CO.)

FLOODWAY DATA

CARROLL CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	WITH FLOODWAY (F.C.D.)	WITHOUT FLOODWAY (F.C.D.)	DIFFERENCE (FT.)
Rock Creek							
A	900	46	337	7.48	307.8	306.8[2]	1.0
B	1,530	123	697	3.62	310.6	309.6	1.0
C	2,220	44	237	10.64	311.3	310.5	0.8
D	2,360	65	441	5.72	314.2	314.2	0.0
E	3,610	70	263	9.59	318.7	318.7	0.0
F	4,340	127	597	4.22	325.3	325.1	0.2
G	4,720	83	427	5.26	326.7	326.5	0.2
H	4,910	90	295	7.62	328.0	327.7	0.3
I	5,415	130	601	3.74	331.8	330.9	0.9
J	5,915	140	420	5.35	333.6	333.0	0.6
K	6,045	278	926	2.42	336.8	335.8	1.0
L	6,125	93	424	5.30	336.9	336.8	0.1
M	6,375	102	428	5.25	338.0	337.5	0.5
N	7,005	96	294	7.65	342.3	341.7	0.6
O	7,905	66	282	7.97	349.1	348.3	0.8
P	8,000	42	244	9.21	349.4	348.6	0.8
Q	8,200	100	436	3.00	351.2	350.2	1.0

[1]FEET ABOVE MOUTH
[2]THE 100-YEAR FLOOD ELEVATION ON THE PROFILE IS DUE TO CARROLL CREEK BACKWATER

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF FREDERICK, MD
(FREDERICK CO.)

FLOODWAY DATA

ROCK CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	WITH FLOODWAY (F.C.D.)	WITHOUT FLOODWAY (F.C.D.)	DIFFERENCE (FT.)
Rock Creek Continued							
R	8,400	209	387	3.37	351.8	351.3	0.5
S	8,640	39	135	9.67	353.7	353.7	0.0
T	9,420	100	193	6.77	364.5	364.5	0.0
U	9,720	307	343	3.81	366.7	365.9	0.8
V	9,935	51	238	5.49	371.3	371.2	0.1
W	11,500	80	195	6.70	393.3	392.7	0.6
X	12,310	149	202	6.47	412.3	411.3	1.0
Tributary No. 5							
A	175	22	60.8	9.61	321.5[2]	321.5[2]	0.0
B	520	32	80.0	7.23	328.4	328.4	0.0
C	860	8	15.6	12.95	333.3	333.3	0.0
D	1,410	50	48.4	4.17	346.5	346.5	0.0

[1]FEET ABOVE MOUTH
[2]THE 100-YEAR FLOOD ELEVATION ON THE PROFILE IS DUE TO ROCK CREEK BACKWATER

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF FREDERICK, MD
(FREDERICK CO.)

FLOODWAY DATA

ROCK CREEK AND TRIBUTARY No. 5

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	WITH FLOODWAY (F.C.D.)	WITHOUT FLOODWAY (F.C.D.)	DIFFERENCE (FT.)
Tributary No. 6							
A	310	33	175	3.09	293.8	292.8[2]	1.0
B	1,250	31	70	7.67	297.7	297.7	0.0
C	1,425	22	139	3.88	302.7	301.7	1.0
D	1,675	34	80	6.77	302.2	301.7	0.5
E	1,940	33	49	11.00	302.3	302.3	0.0
F	2,130	12	37	14.76	303.3	303.3	0.0
G	2,275	31	106	5.11	307.4	307.4	0.0
H	2,500	15	31	17.72	307.6	307.6	0.0
I	2,660	12	75	7.23	313.2	313.2	0.0
J	2,940	31	113	4.80	313.2	313.2	0.0
K	3,065	13	57	9.49	315.8	315.8	0.0
L	3,430	12	48	11.34	315.8	315.8	0.0
M	3,540	15	51	10.61	318.6	318.4	0.2
N	3,610	31	107	5.07	319.8	318.9	0.9
O	3,950	13	27	20.00	321.2	321.2	0.0
P	4,140	15	32	16.77	325.6	325.6	0.0
Q	4,390	29	160	3.39	331.9	331.6	0.3

[1]FEET ABOVE MOUTH
[2]THE 100-YEAR FLOOD ELEVATION ON THE PROFILE IS DUE TO CARROLL CREEK BACKWATER

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF FREDERICK, MD
(FREDERICK CO.)

FLOODWAY DATA

TRIBUTARY No. 6

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	WITH FLOODWAY (F.C.D.)	WITHOUT FLOODWAY (F.C.D.)	DIFFERENCE (FT.)
Tributary No. 6 Continued							
R	4,900	50	235	1.10	336.7	336.7	0.0
S	5,675	30	52	4.97	347.5	347.2	0.3
T	5,775	30	47	5.54	348.9	348.9	0.0
U	7,700	23	45	5.70	400.7	400.6	0.1
Tributary No. 8							
A	3,500	60	276	4.30	265.5	264.5[2]	1.0
B	4,475	40	547	1.87	272.6	271.7	0.9
C	5,435	88	344	2.97	277.4	276.4	1.0
D	6,675	33	119	8.60	280.8	280.2	0.6
E	7,280	209	543	1.88	283.1	282.1	1.0
F	7,770	42	174	5.88	283.4	283.4	0.0

[1]FEET ABOVE MOUTH

[2]THE 100-YEAR FLOOD ELEVATION ON THE PROFILE IS DUE TO MONOCACY RIVER BACKWATER

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF FREDERICK, MD
(FREDERICK CO.)

FLOODWAY DATA

TRIBUTARIES No. 6 AND 8

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	WITH FLOODWAY (F.C.D.)	WITHOUT FLOODWAY (F.C.D.)	DIFFERENCE (FT.)
Tributary No. 9							
A	811	30	77	7.66	265.9	265.4[2]	0.5
B	923	31	93	6.34	268.0	267.0[2]	1.0
C	1,670	43	112	5.27	275.0	274.1	0.9
D	2,075	44	88	6.70	281.2	280.5	0.7
Tributary No. 10							
A	690	25	53	8.32	259.2[2]	259.0[2]	0.2
Tributary No. 11							
A	550	18	30	8.40	264.5[2]	264.4[2]	0.1

[1]FEET ABOVE MOUTH
[2]THE 100-YEAR FLOOD ELEVATION ON THE PROFILE IS DUE TO MONOCACY RIVER BACKWATER

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF FREDERICK, MD
(FREDERICK CO.)

FLOODWAY DATA

TRIBUTARIES No. 9, 10 AND 11

Where encroachment on the 100-year flood plain indicated hazardous velocities would be encountered, the extent of encroachment was limited to where the hazardous velocities would not be reached. The most up-to-date version of the HEC-2 program was used for determination of floodway encroachment stations, after the previous version of the program was corrected by the Hydrologic Engineering Center of the COE to include the friction effects of encroachments according to the suggestions offered by Dalton•Dalton•Little•Newport (References 17 and 18).

As shown on the Flood Boundary and Floodway Map, the floodway widths were determined at cross sections; between cross sections the boundaries were interpolated.

In cases where the floodway and the 100-year boundaries are close together, only the floodway boundary has been shown.

Where a minor stream is under the influence of the backwater from a major stream, the floodway width is based on a condition of no flood backwater effect from the major stream.

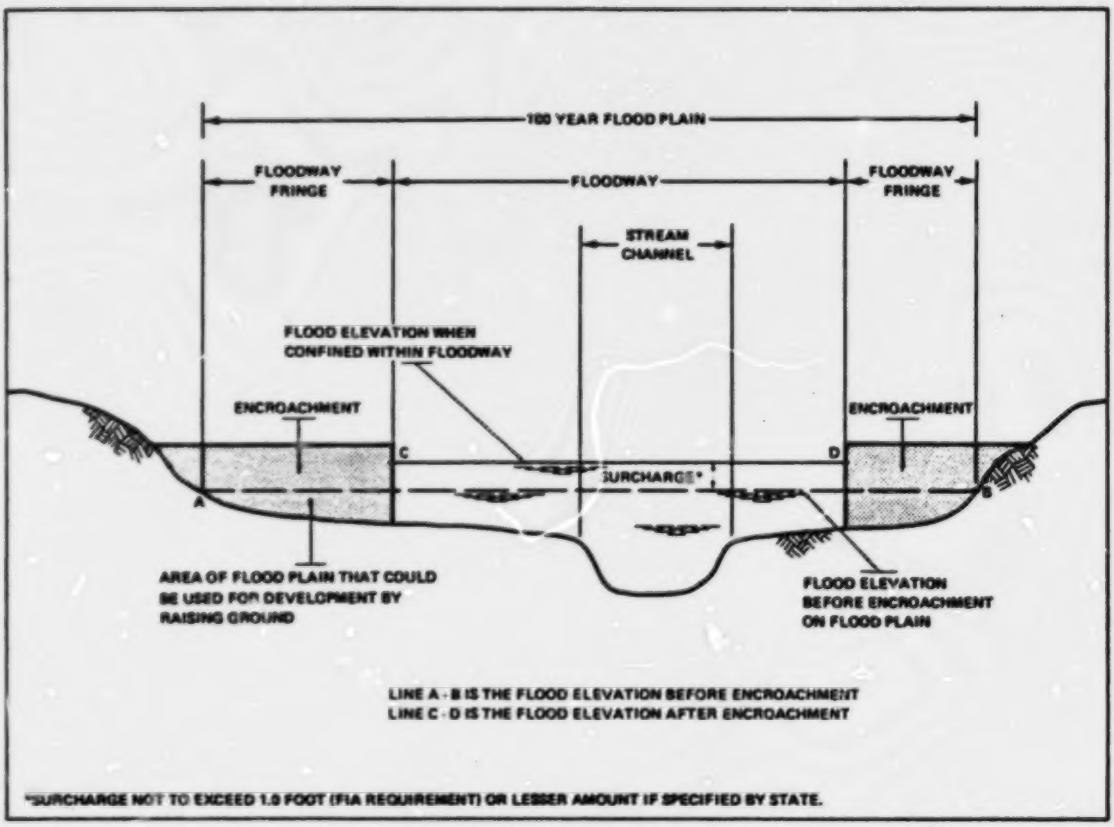
On Tributary No. 8, no floodway has been determined between Motter Avenue and Fairview Avenue since this reach is planned to be enclosed in a pipe culvert if and as the area develops.

Culverts under North Market Street control the flood flow from the upper reaches of both tributaries No. 10 and 11. After determining the discharge through these culverts, floodways were determined by hand calculation for Tributaries No. 10 and 11.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses that portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than one foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 5.

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FIA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source affecting the City of Frederick.


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
A
B
SURCHARGE*
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC Figure 5

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot

Seventeen reaches meeting the above criteria were required for the flooding sources of Frederick. These included nine on Carroll Creek,

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two on Tributary No. 8, one each on Rock Creek and Tributary No. 5, three on Tributary No. 6, and one on Tributary No. 9. The locations of the reaches are shown on the Flood Profiles (Exhibit 1).

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is the FIA device used to correlate flood information with insurance rate tables. Correlations between property damages from floods and FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest one-half foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of Frederick was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods, no base flood elevations shown or FHFs determined.
Zones A1, A2, A3, A4, A5, A6, A9, A16:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevation shown, and zones subdivided according to FHFs.
Zone B:	Areas between Zones A1, A2, A3, A4, A5, A6, A9, A16, and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; and areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot. Zone B is not subdivided.

Zone C: Areas not subject to flooding by the 500-year flood. Zone C is not subdivided.

Table 3, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community. The Monocacy River was determined to have an A16 zone. This value was assigned to backwater, from the Monocacy River, on its tributaries. Data for Tributaries No. 10 and 11 are not shown in Table 3 because the entire reaches of these flooding sources are affected by backwater from the Monocacy River.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Frederick is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

6.0 OTHER STUDIES

A study prepared for the City of Frederick (Reference 4) was reviewed in detail. This study covered the potential flooding in the city from Carroll Creek, Rock Creek, Tributary No. 5, and a portion of Tributaries No. 6 and 8 covered by this report.

The cross sections prepared by the city's contractor were used and supplemented with additional cross sections as required.

The city study covered the flooding from the 10-year, 50-year, and 100-year flood based on ultimate development of the watershed as allowed by the Master Plan for the city. Discharges for these floods were compared and the city study discharges were accepted.

Water-surface profiles were developed for this study and were found to agree exactly with the computed results from the city's study except when the streams are under the influence of the Monocacy River. The city's contractor used the published COE water-surface elevation for the Monocacy River (Reference 21) which was based on discharges calculated on gage data up to 1967. Using gage data through 1975 resulted in a substantially

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3]
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Carroll Creek							
Reach 1	0004	-1.75	-1.10	+5.21	020	A4	Varies
Reach 2	0004	-0.88	-0.43	+2.86	010	A2	Varies
Reach 3	0004	-1.28	-0.44	+0.79	015	A3	Varies
Reach 4	0004	-2.59	-0.96	+1.64	025	A5	Varies
Reach 5	0004	-1.88	-0.70	+1.20	020	A4	Varies
Reach 6	0003	-0.90	-0.44	+0.89	010	A2	Varies
Reach 7	0003	-3.15	-1.04	+3.33	030	A6	Varies
Reach 8	0003	-1.35	-0.95	+3.85	015	A3	Varies
Reach 9	0003	-3.02	-0.71	+1.41	030	A6	Varies
Rock Creek							
Reach 1	0003	-0.90	-0.26	+0.97	010	A2	Varies
Tributary No. 5							
Reach 1	0003	-0.40	-0.23	+0.55	005	A1	Varies

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT –SEE MAP

TABLE 3

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF FREDERICK, MD
(FREDERICK CO.)

FLOOD INSURANCE ZONE DATA

CARROLL CREEK, ROCK CREEK, AND TRIBUTARY No. 5

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3]
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Tributary No. 6							
Reach 1	0003	-0.82	-0.33	+0.73	010	A2	Varies
Reach 2	0003	-1.91	-0.50	+4.40	020	A4	Varies
Reach 3	0003	-0.61	-0.23	+0.47	005	A1	Varies
Tributary No. 8							
Reach 1	0004	-0.75	-0.30	+2.70	010	A2	Varies
Reach 2	0004	-0.40	-0.20	+0.20	005	A1	Varies
Tributary No. 9							
Reach 1	0004	-0.70	-0.30	+3.00	005	A1	Varies

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT –SEE MAP

TABLE 3

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF FREDERICK, MD
(FREDERICK CO.)

FLOOD INSURANCE ZONE DATA

TRIBUTARIES No. 6 , 8 AND 9

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difference range of discharges. Resolution of differences with the COE is discussed in the following paragraph.

The COEs flood plain information study on the Monocacy River (Reference 21) was compared with the profiles developed for this study. The COE provided the cross sections used for their study and after field verification they were used for this study. The COE discharge for the 100-year flood was different from the discharge determined for this study but the COE agreed with the revised discharge after review since the data base on their calculation were gage records up to 1967. Discharges for this study were based on gage records up through 1975. The profiles determined by this study, based upon the revised discharge, were reviewed by the COE and after consideration of the excellent agreement with the gage heights for the 10-, 50-, and 100-year discharges at the gage on the Monocacy River approximately three miles downstream from Frederick, the COE indicated agreement with the water-surface profiles developed for this study.

This study is authoritative for purposes of the Flood Insurance Program and the data presented here either supersede or are compatible with previous determinations.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study can be obtained by contacting the office of the Federal Insurance Administration, Regional Director, Curtis Building, Sixth and Walnut Streets, Philadelphia, Pennsylvania 19106.

8.0 BIBLIOGRAPHY AND REFERENCES

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9.0 REVISION DESCRIPTION

9.1 Purpose

The purpose of this revision is to incorporate new and/or revised data into the currently effective Flood Insurance Study for the City of Frederick, Frederick County, Maryland. This Revision Description is intended to provide updated information which aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

9.2 Acknowledgments

The hydrologic and hydraulic analyses in this Revision Description were prepared by Harris, Smariga & Associates, Inc., for Tributary No. 8 using updated topographic maps and revised hydrologic and hydraulic analyses. This work was completed in December 1986. The Federal Emergency Management Agency (FEMA) reviewed and accepted these data for purposes of this revision.

9.3 Scope

This revision incorporated changes to Tributary No. 8 from Motter Avenue to approximately 750 feet upstream of Fairview Avenue.

9.4 Hydrologic and Hydraulic Analyses

The 100-year flood discharge for Tributary No. 8 at Motter Avenue was estimated by a Technical Release No. 20 (TR-20) hydrologic model (Reference 1). Because of this updated hydrologic analysis for the upper portion of this tributary, previously estimated discharges downstream of Motter Avenue are subject to error. Further study will need to be undertaken to estimate those discharges that reflect the existing conditions.

Table 1, "Summary of Discharges ", is a summary of the drainage area-peak discharge relationships for the streams studied by detailed methods. An addendum for the summary of the drainage area-peak discharge relationships for the additional detailed study for Tributary No. 8 is shown in Table A.

TABLE A - SUMMARY OF DISCHARGES ADDENDUM

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
Tributary No. 8 At Motter Avenue	0.30	*	*	1,107	*

*Data not available

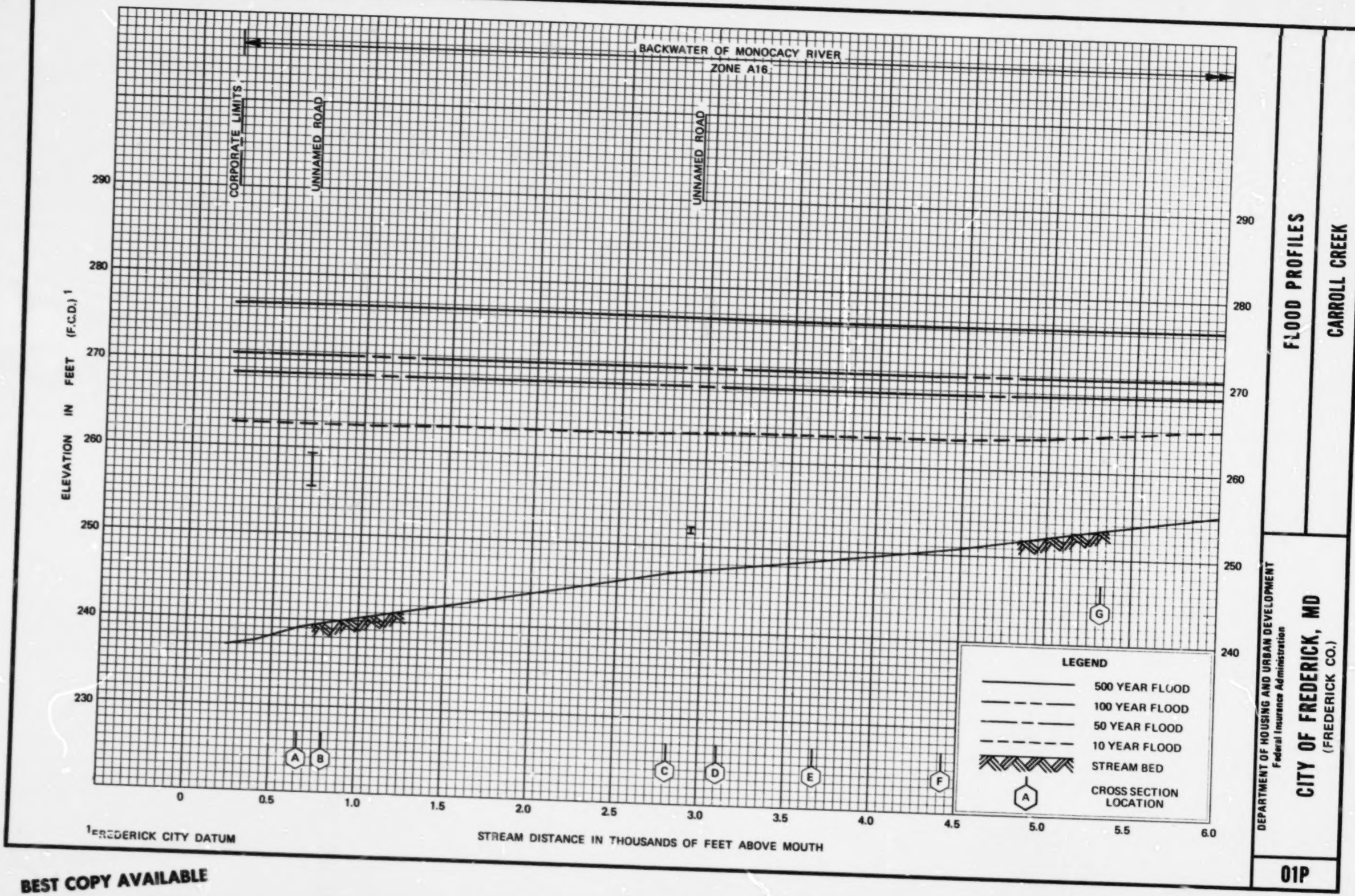
The flood profile for Tributary No. 8 was updated to reflect the existing conditions upstream of Motter Avenue. The 100-year water-surface profile was shown discontinuously at Motter Avenue because of the unavailability of data downstream. Until such data is available and incorporated into this study, currently effective information should be used.

9.5 Revisions Bibliography

1. U. S. Department of Agriculture, Soil Conservation Service, Technical Release No. 20, Computer Program, Project Formulation, Hydrology, Washington, D. C., 1965.

9.6 Location of Data

Information concerning the pertinent data used in preparation of this study can be obtained by contacting FEMA, the Natural and Technological Hazards Division, Liberty Square Building (Second Floor), 105 South Seventh Street, Philadelphia, Pennsylvania 19106.



FLOOD PROFILES

CARROLL CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF FREDERICK, MD
(FREDERICK CO.)

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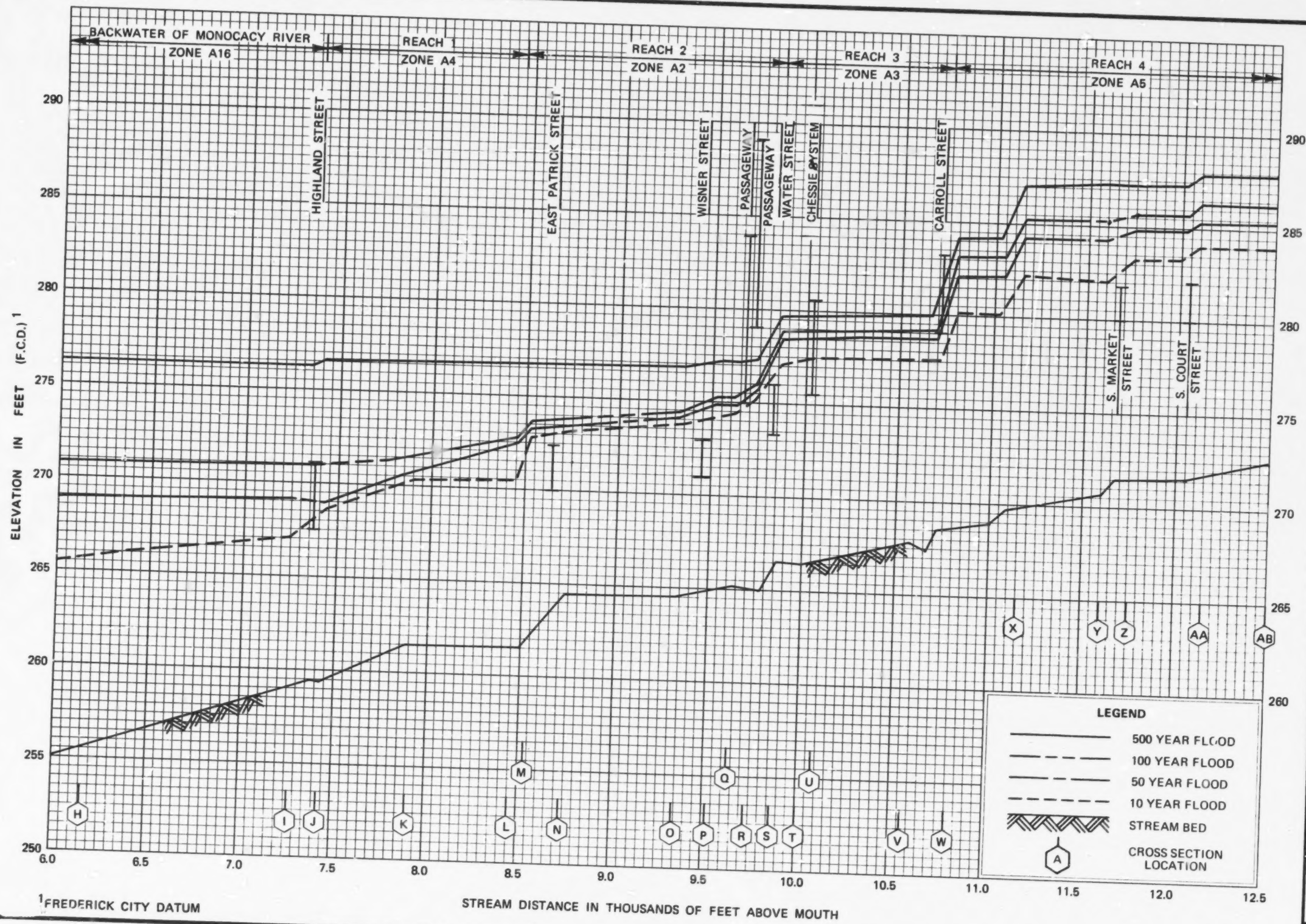

FLOOD PROFILES

CARROLL CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF FREDERICK, MD
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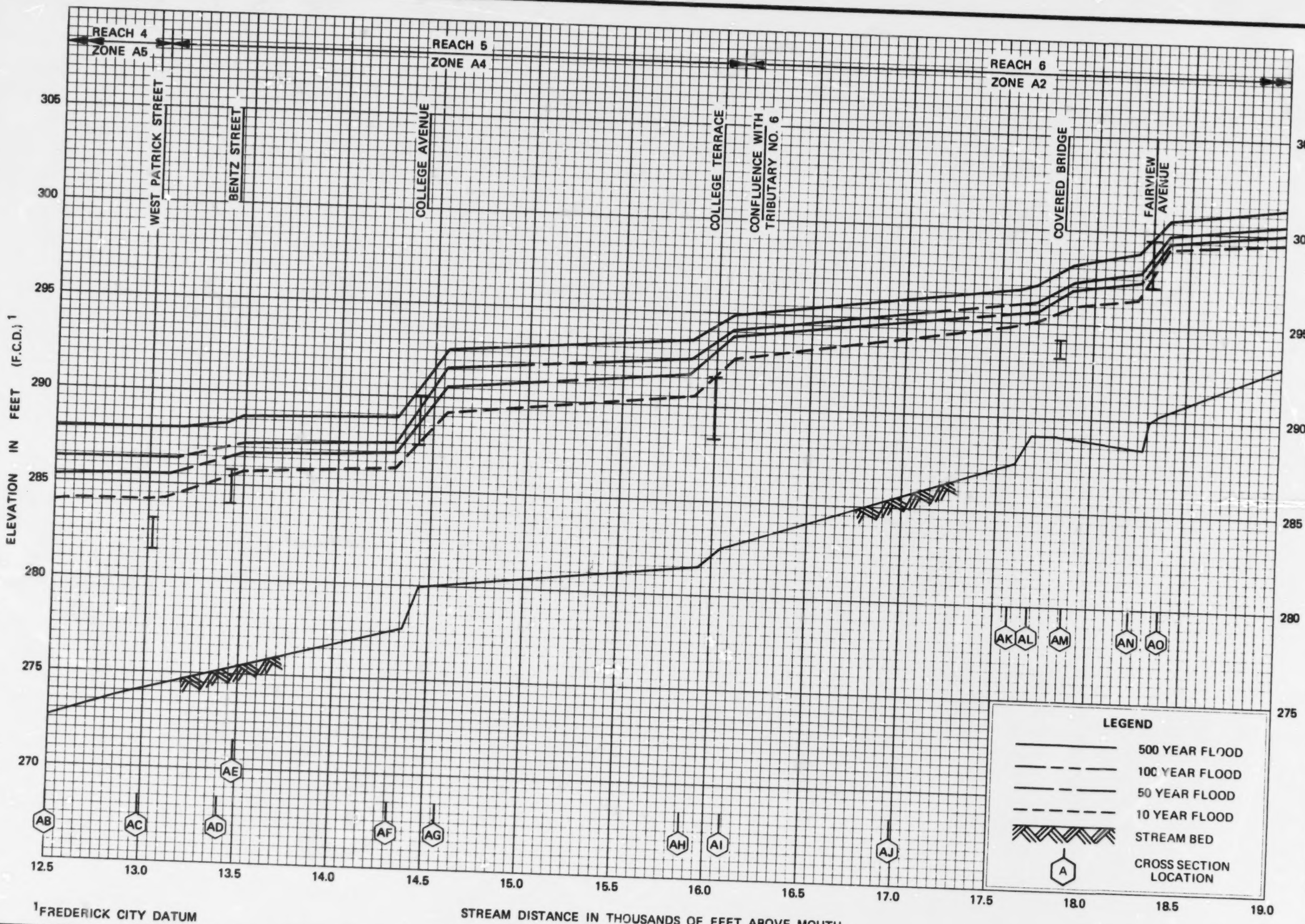

FLOOD PROFILES

CARROLL CREEK

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Federal Insurance Administration

CITY OF FREDERICK, MD
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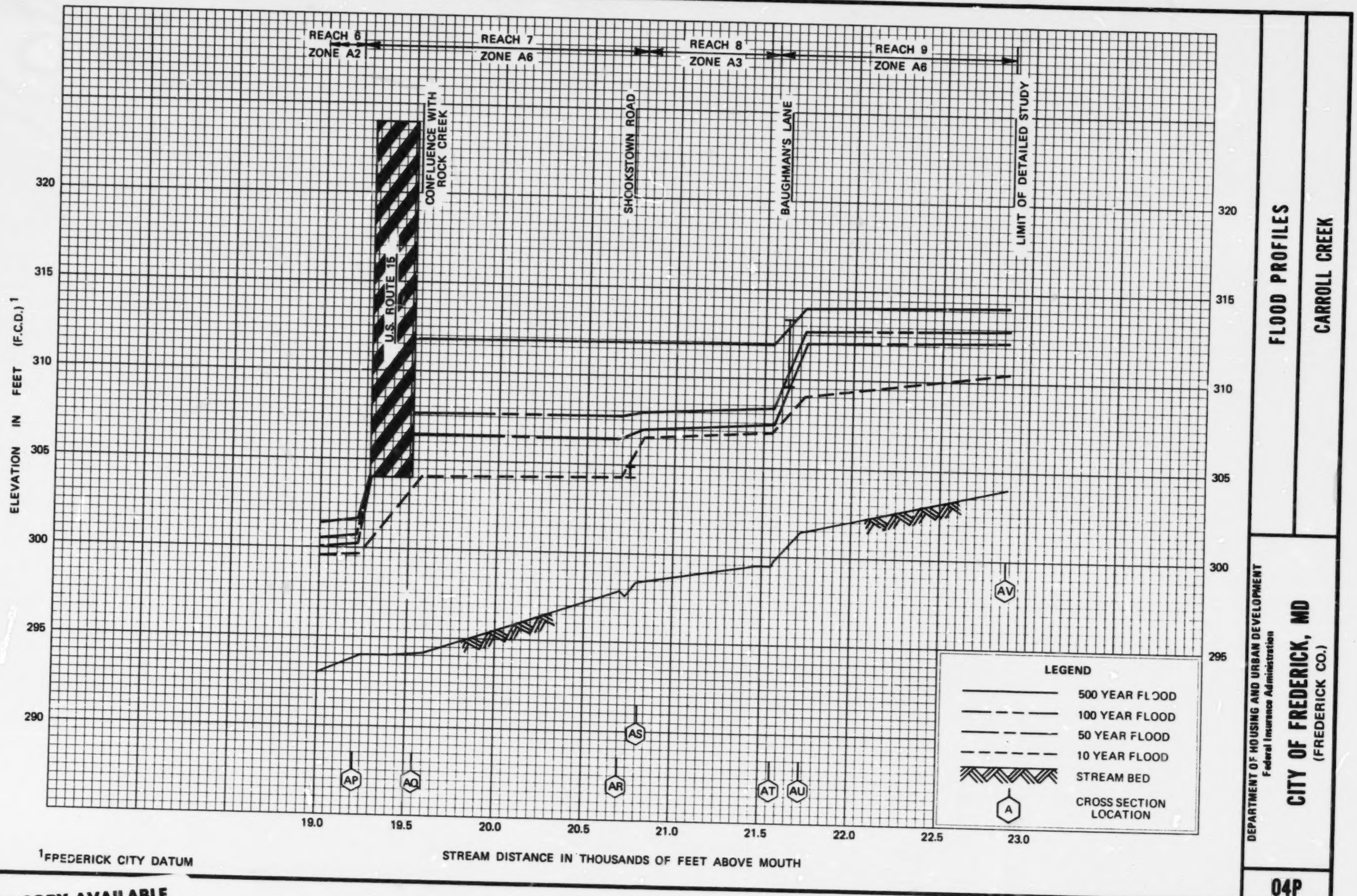

FLOOD PROFILES

CARROLL CREEK

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Federal Insurance Administration

CITY OF FREDERICK, MD
(FREDERICK CO.)

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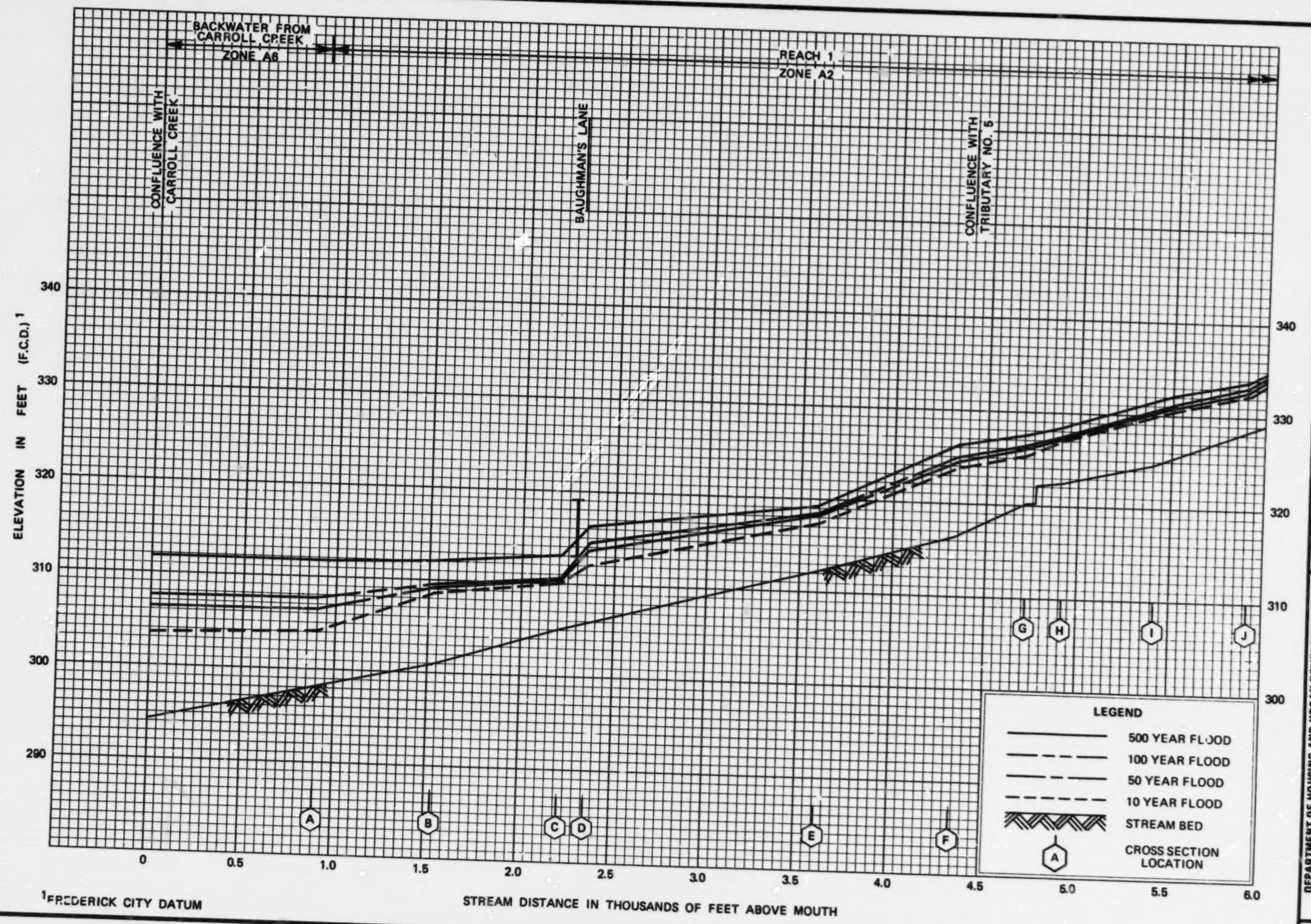

FLOOD PROFILES

ROCK CREEK

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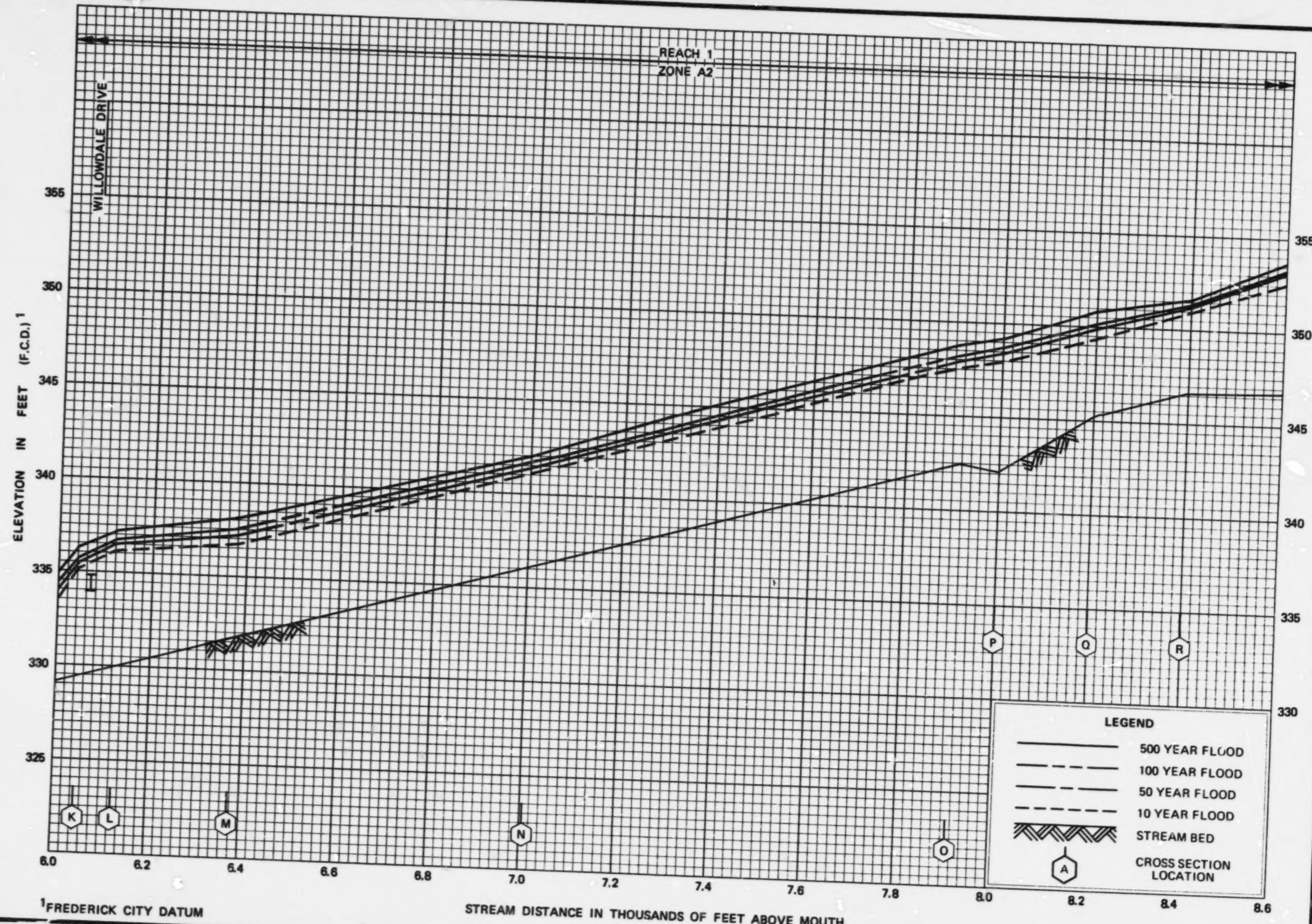

FLOOD PROFILES

ROCK CREEK

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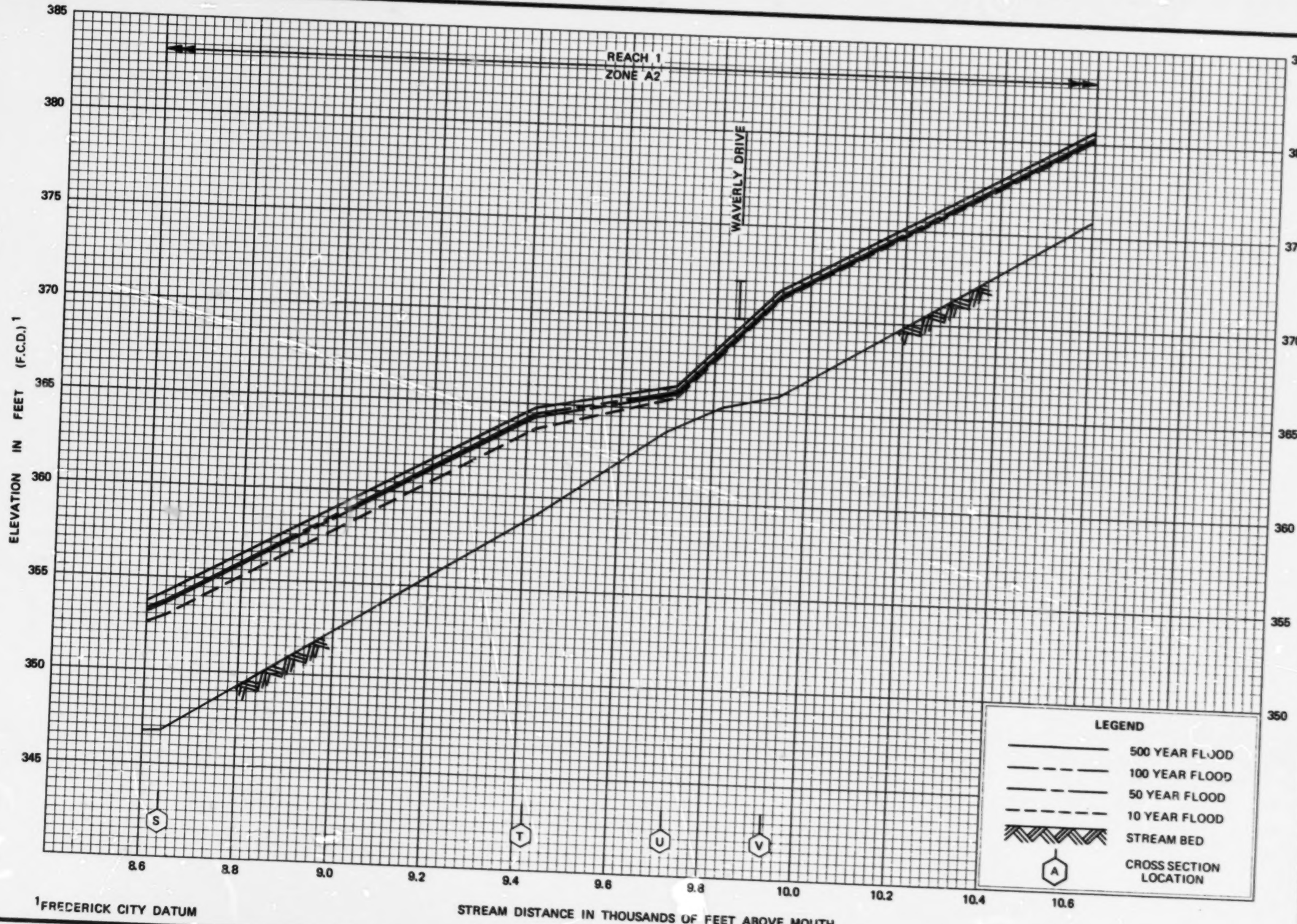

[1]FREDERICK CITY DATUM

STREAM DISTANCE IN THOUSANDS OF FEET ABOVE MOUTH

FLOOD PROFILES

ROCK CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF FREDERICK, MD
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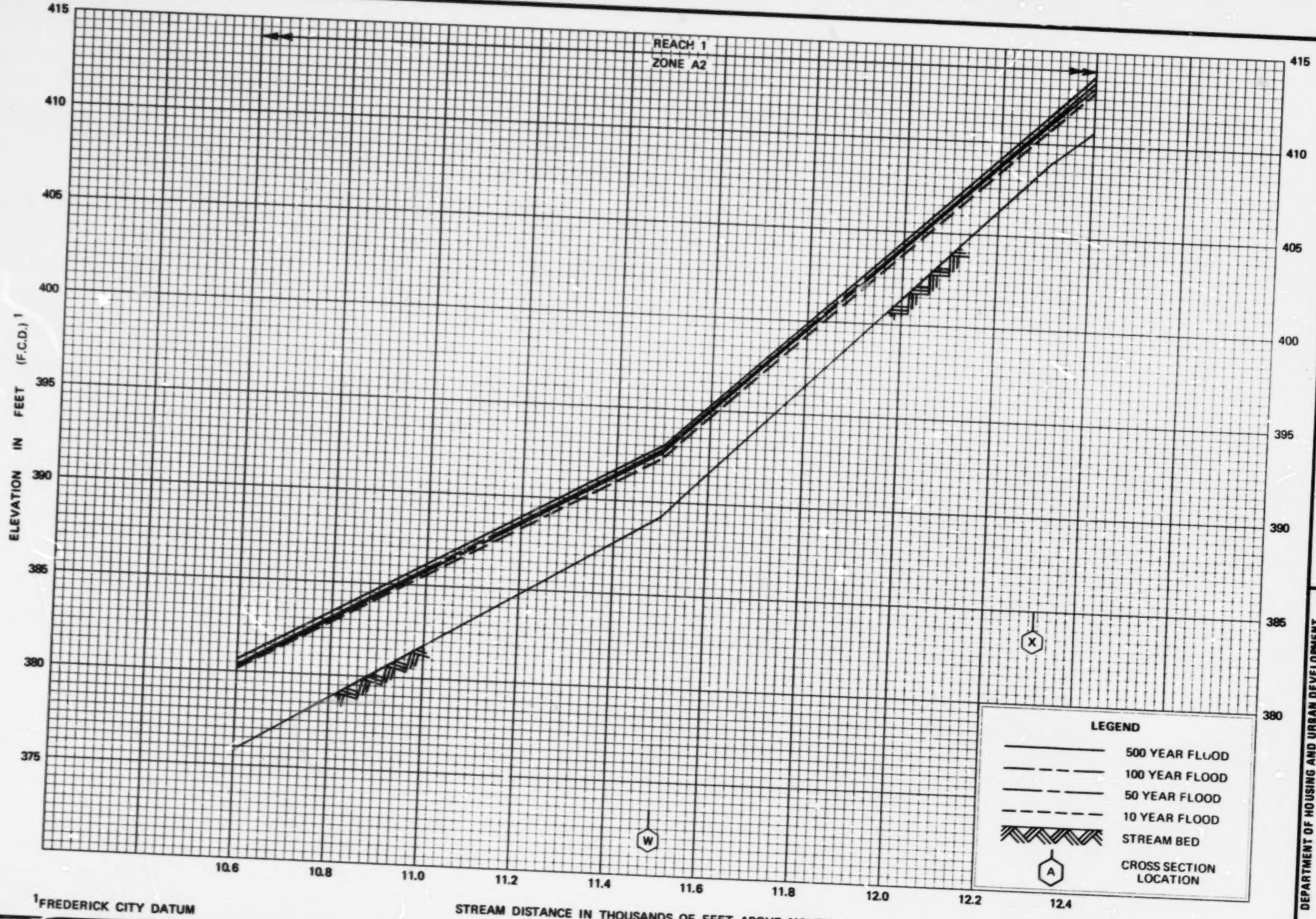

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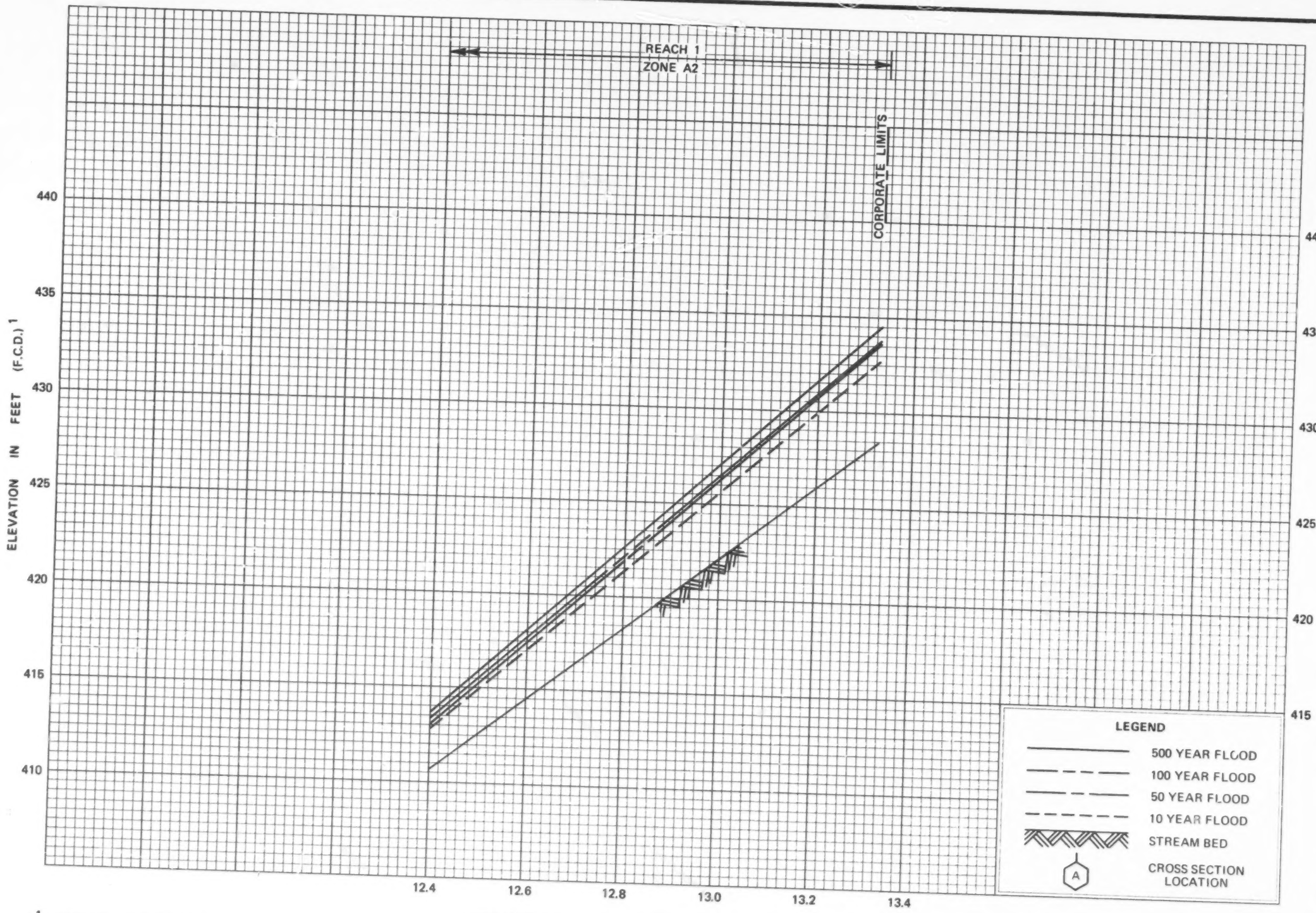

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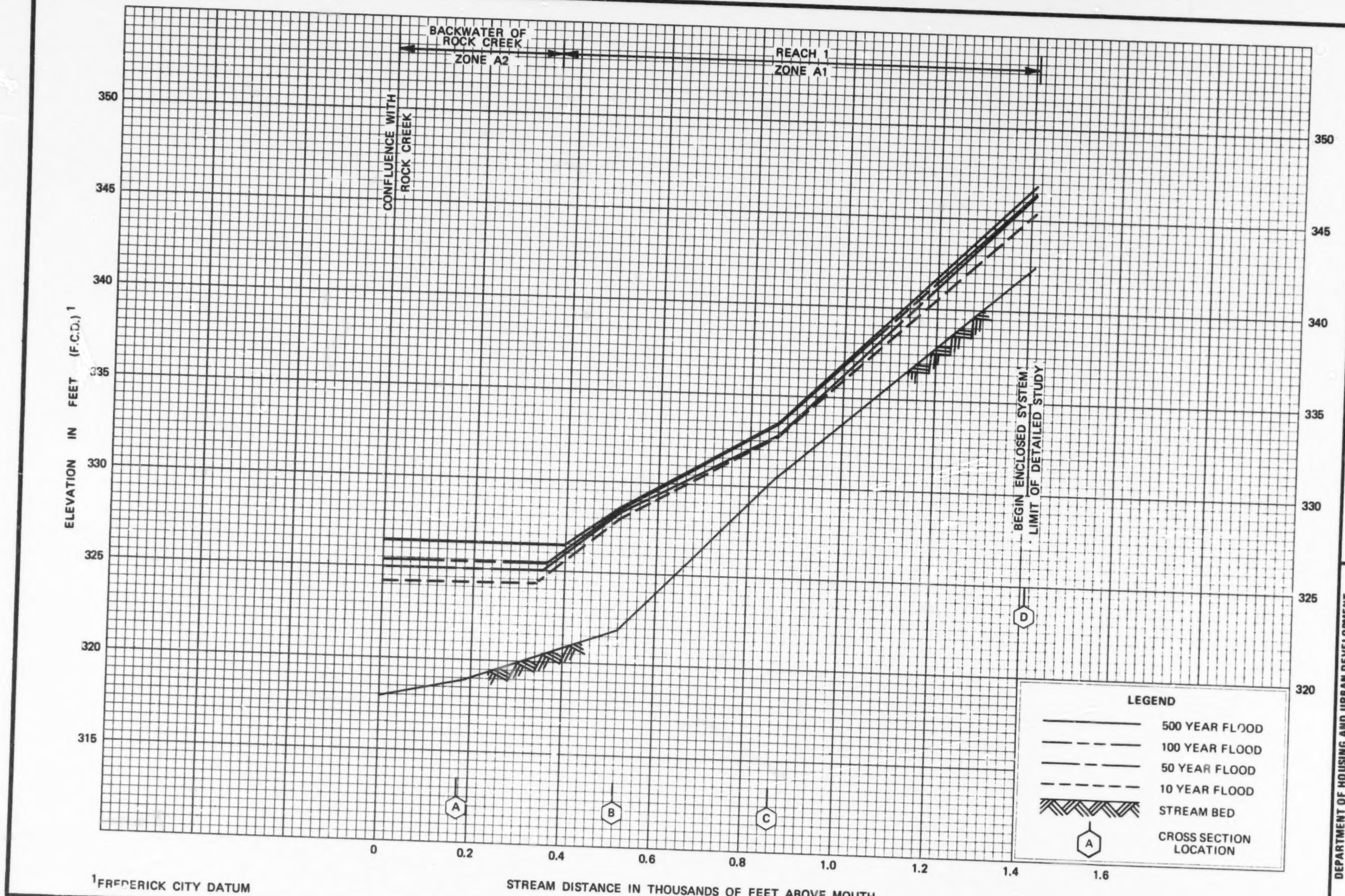

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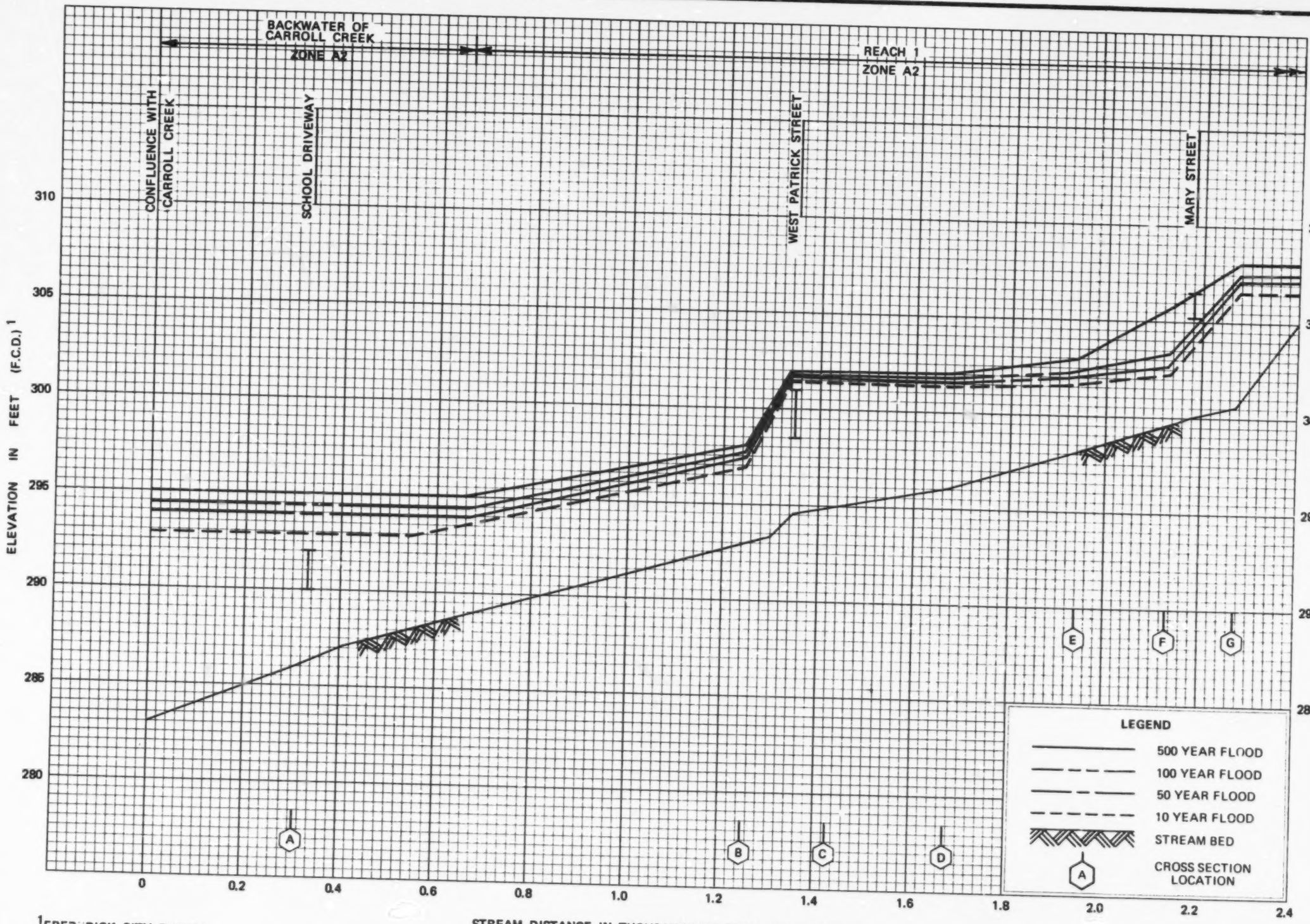

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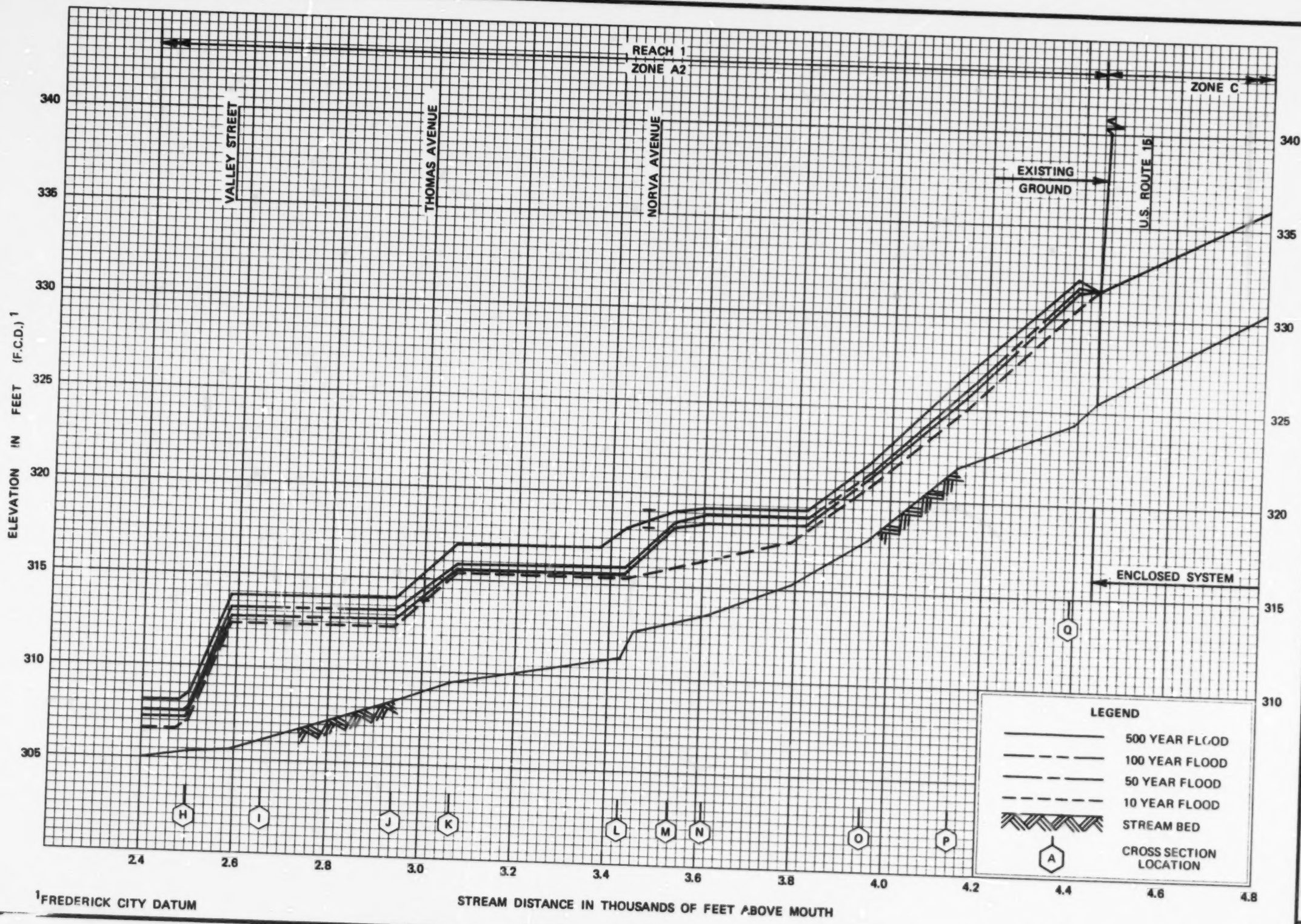

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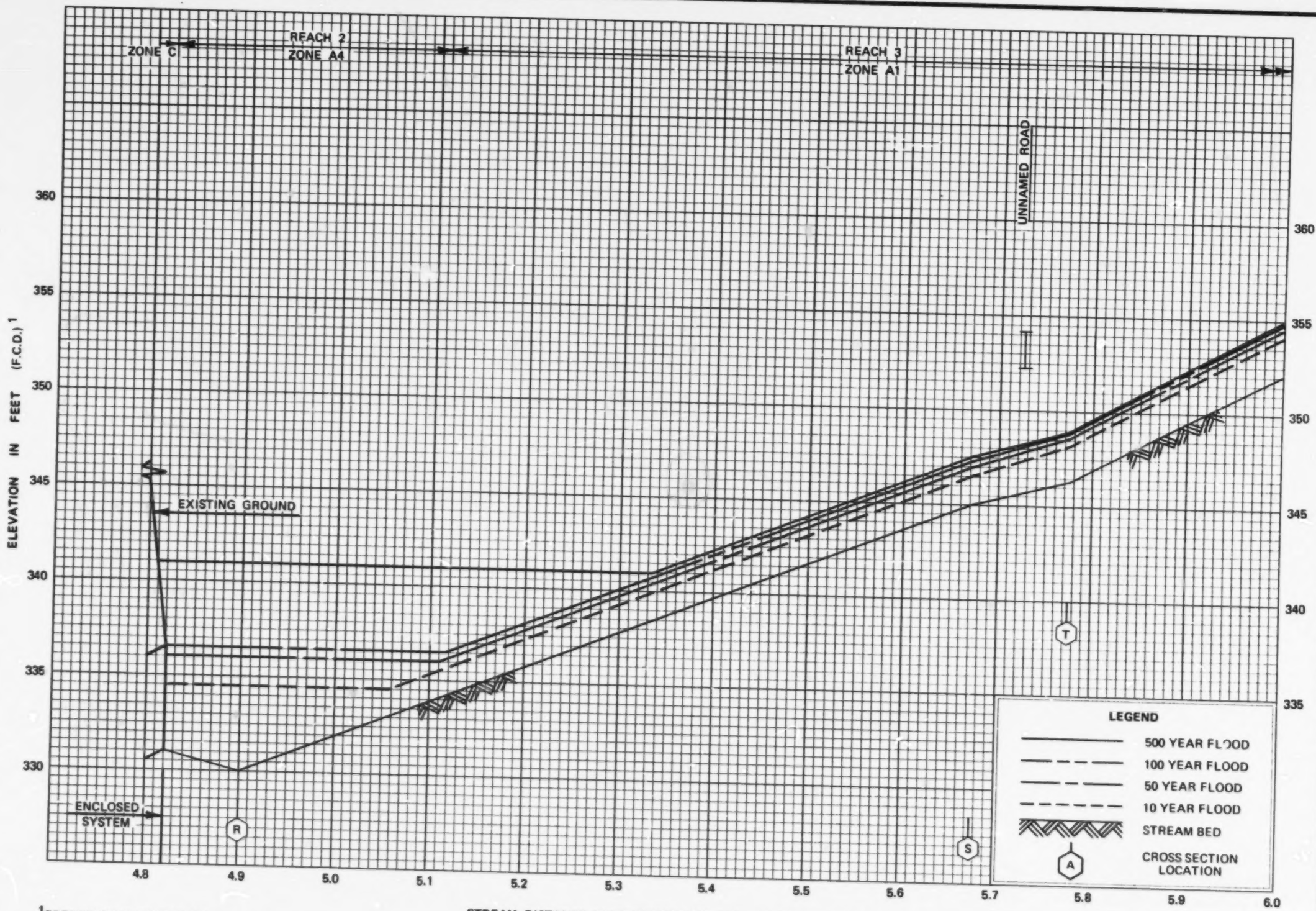

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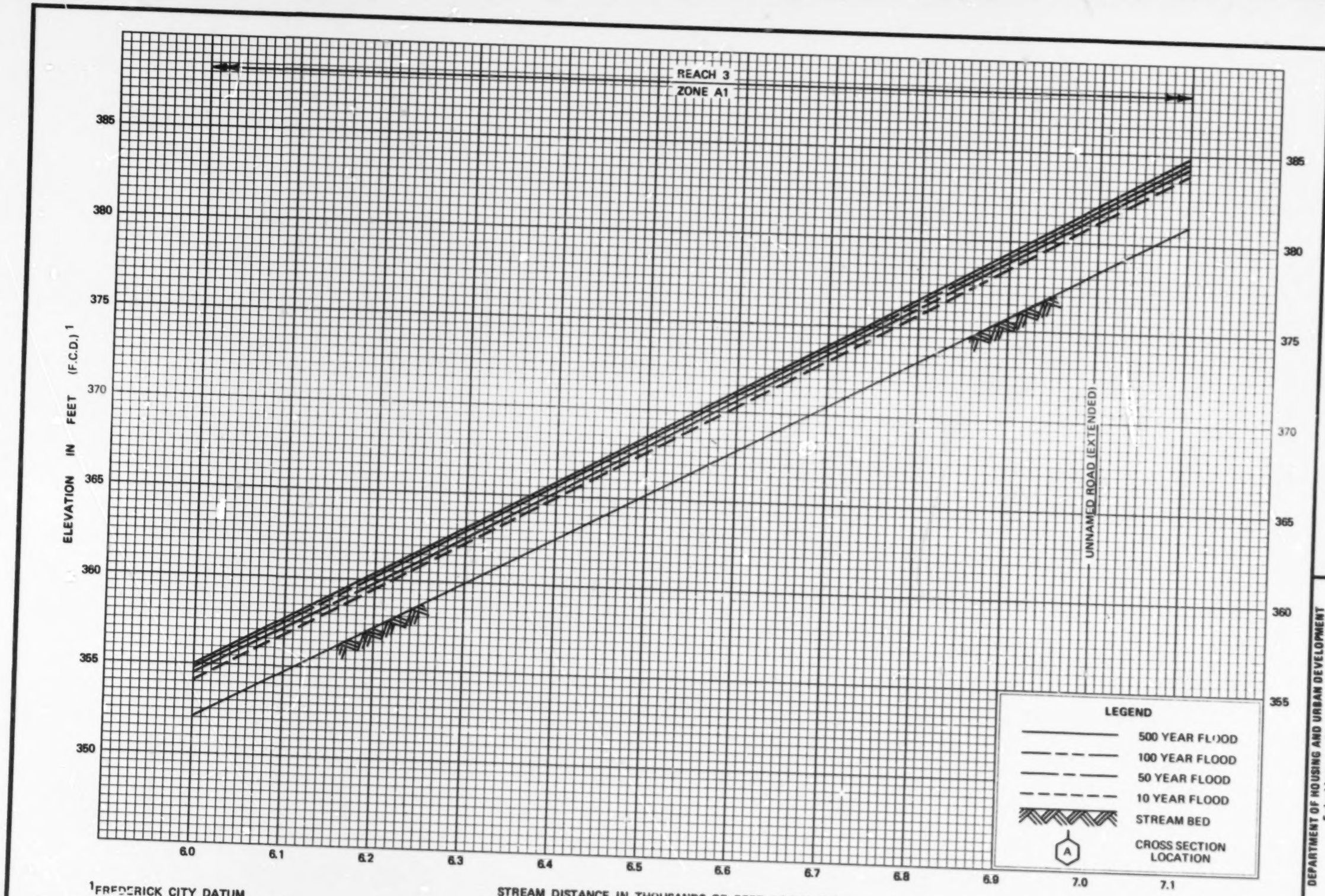

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REACH 3
ZONE A1

LIMIT OF DETAILED STUDY

ELEVATION IN FEET (F.C.D.)[1]

405
400
395
390
385
380

7.1 7.2 7.3 7.4 7.5 7.6 7.7

STREAM DISTANCE IN THOUSANDS OF FEET ABOVE MOUTH

[1]FREDERICK CITY DATUM

LEGEND

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- CROSS SECTION LOCATION (A)

U

FLOOD PROFILES

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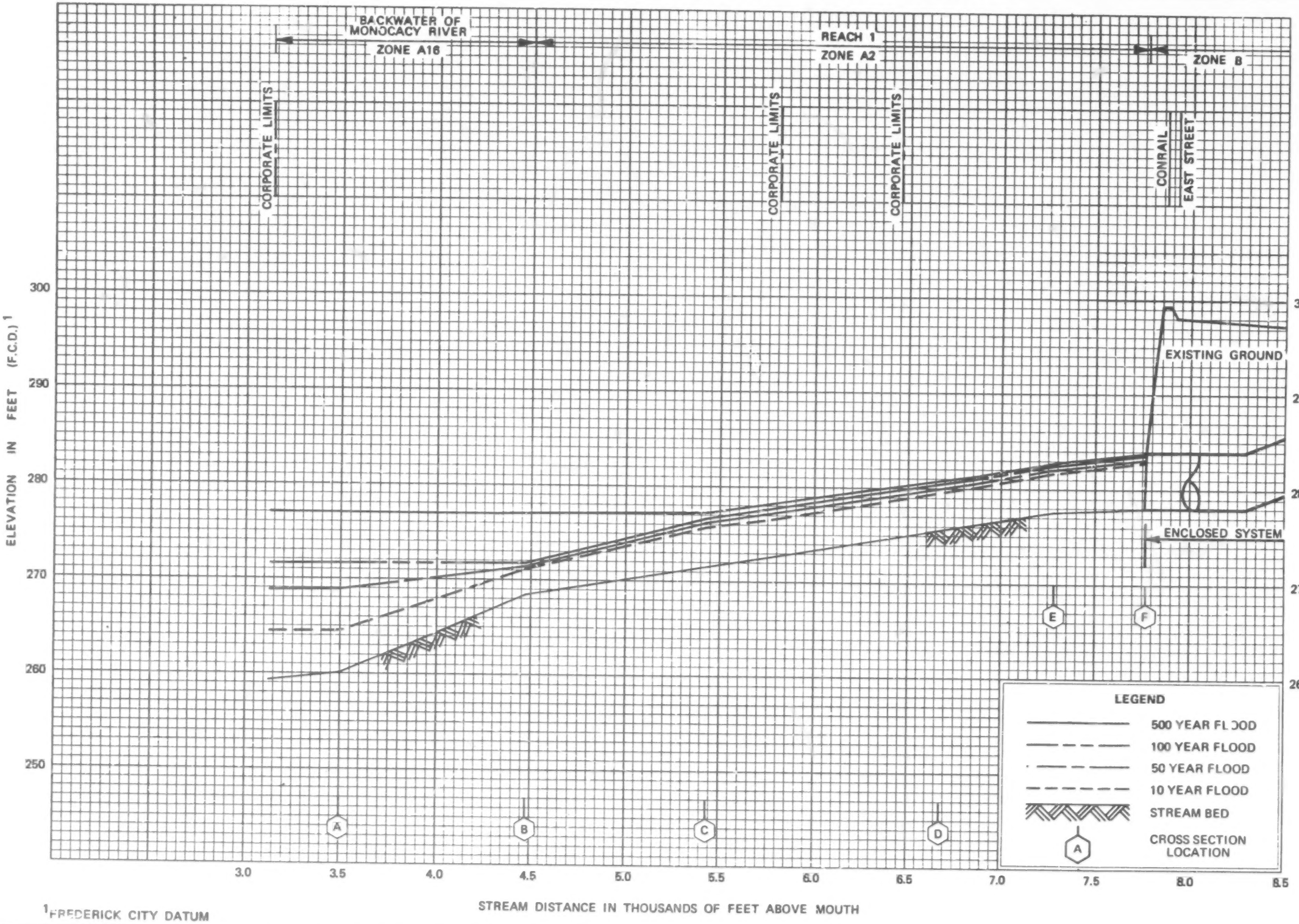

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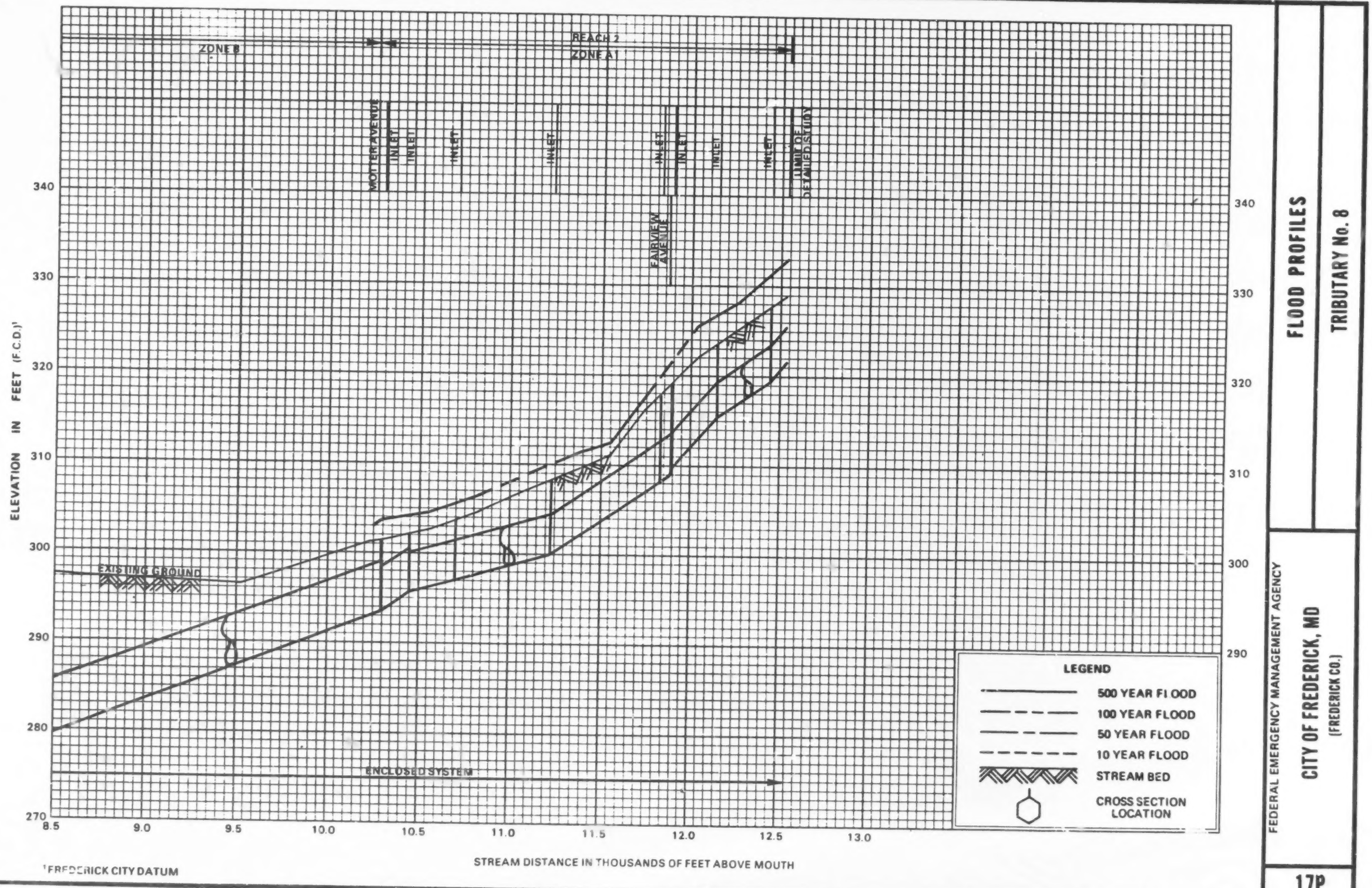

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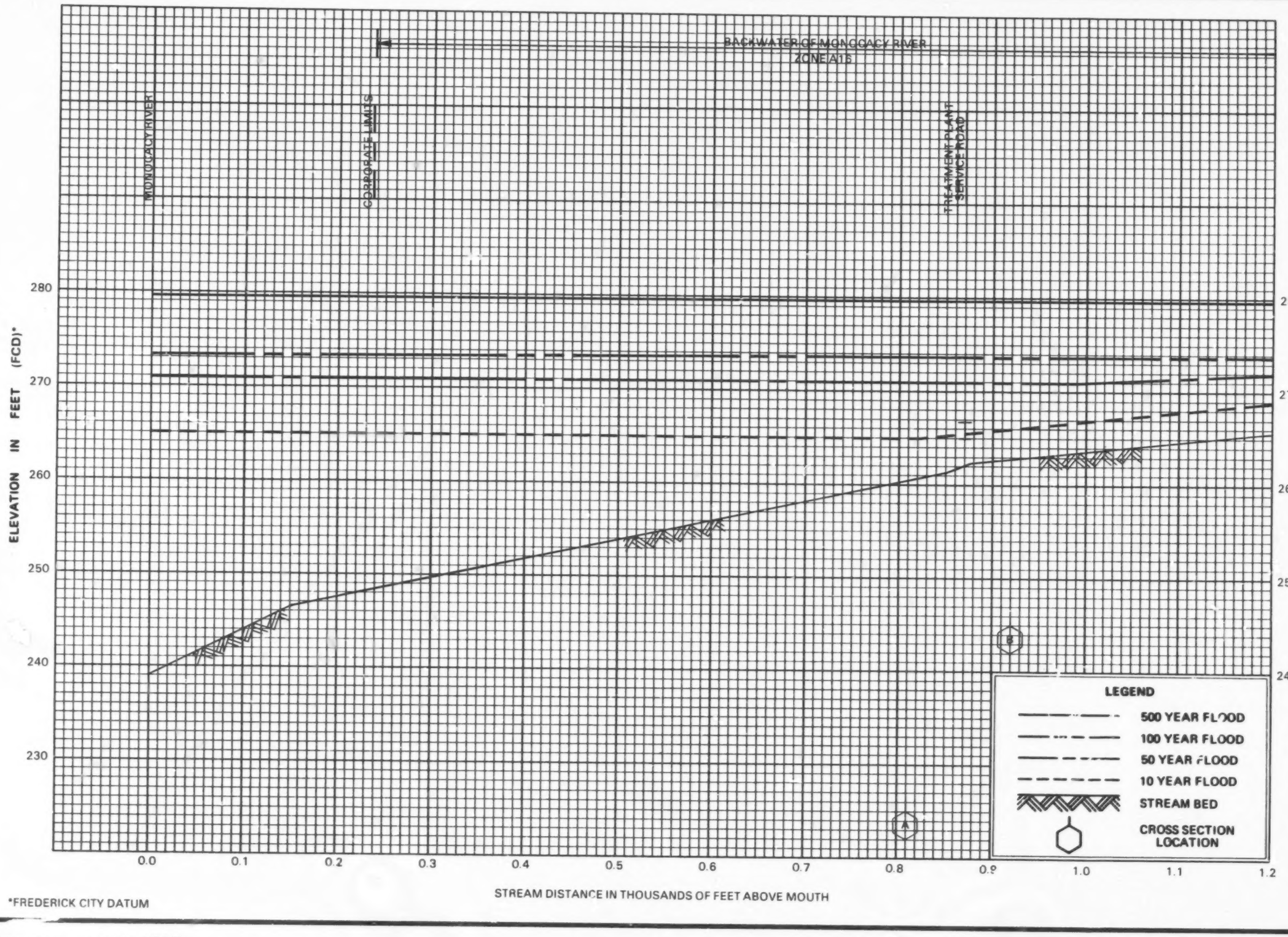

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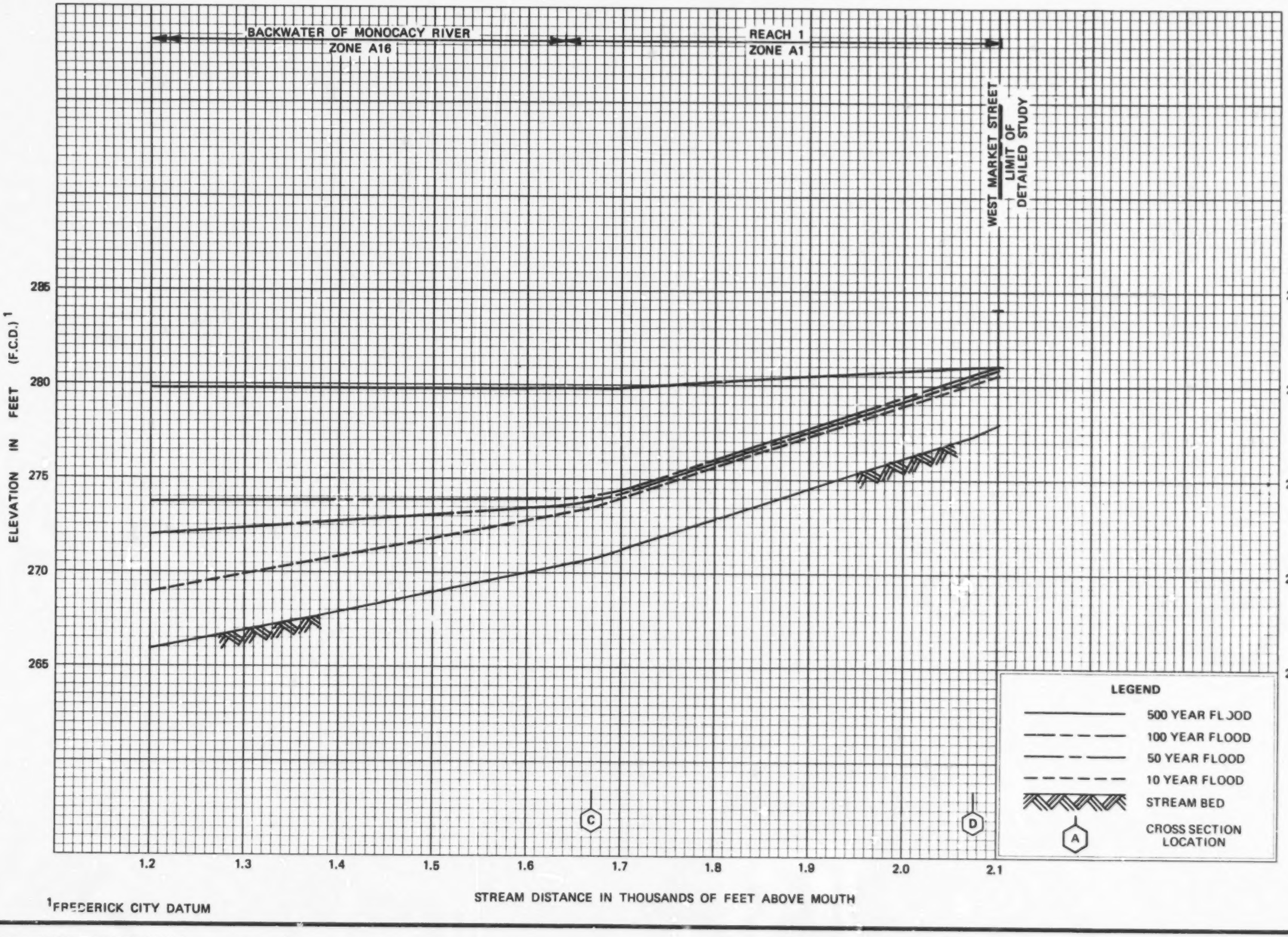

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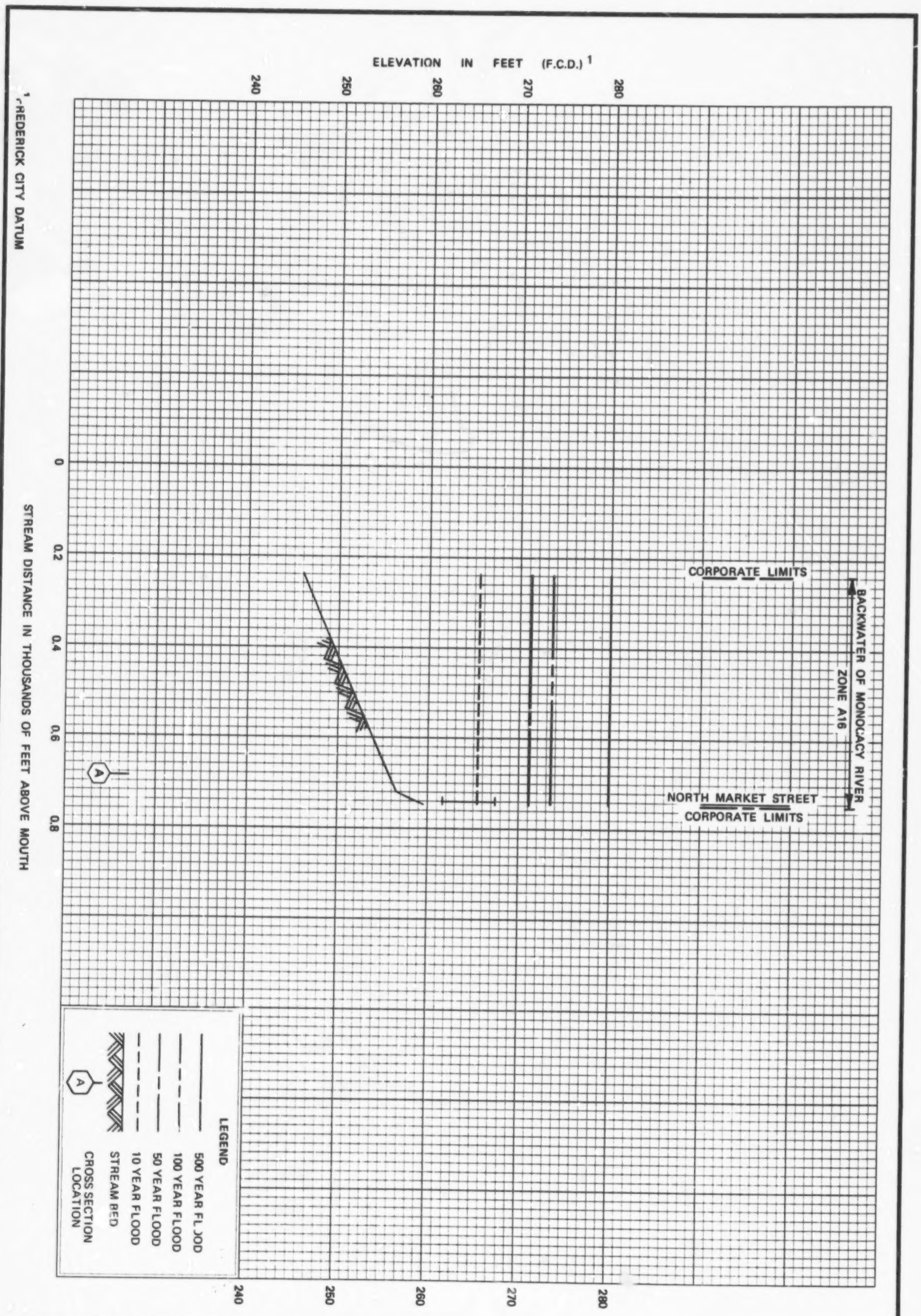

20P	DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT Federal Insurance Administration **CITY OF FREDERICK, MD** (FREDERICK CO.)	**FLOOD PROFILES** **TRIBUTARY No. 10**

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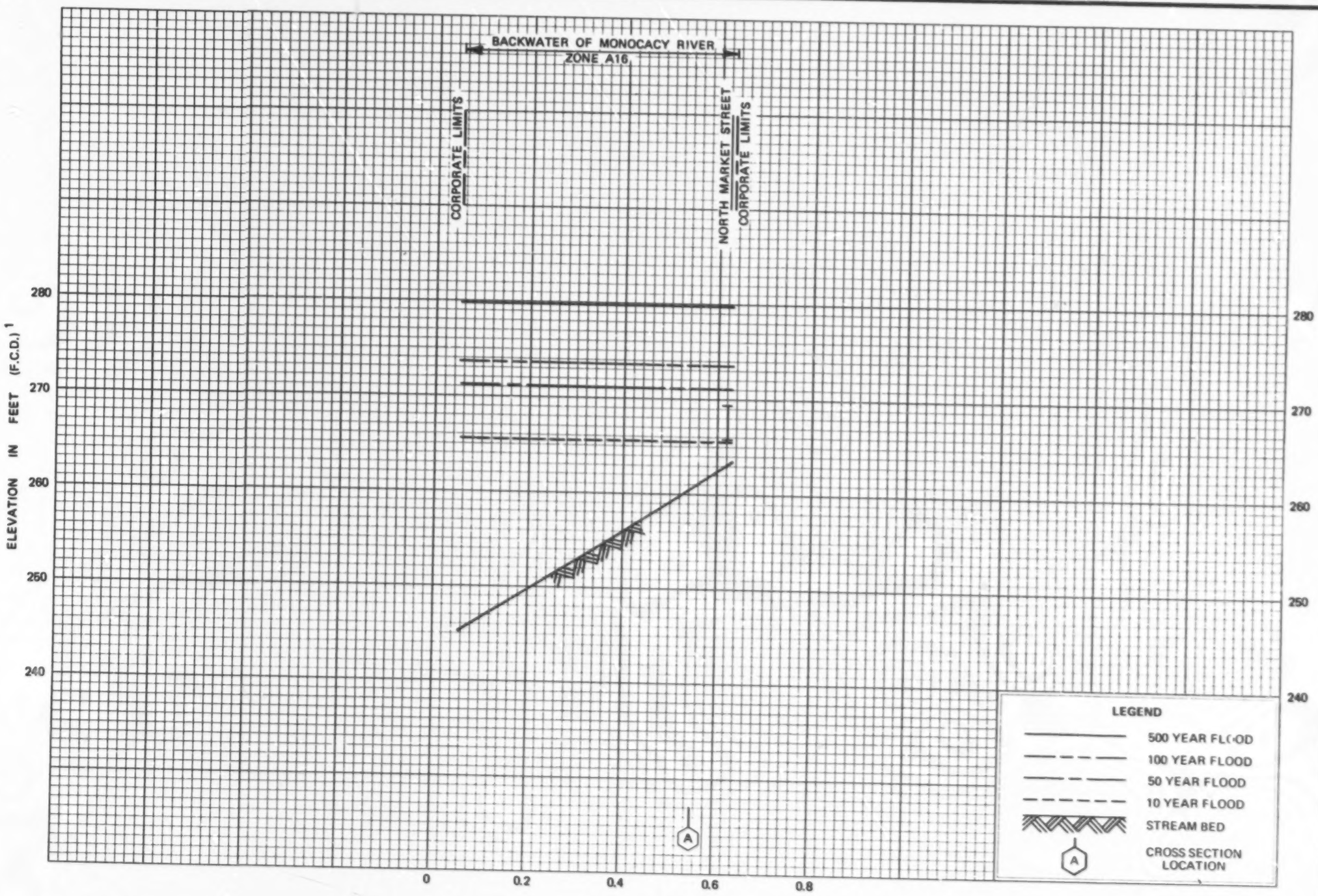

[1]FREDERICK CITY DATUM

STREAM DISTANCE IN THOUSANDS OF FEET ABOVE MOUTH

FLOOD PROFILES

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